JOURNAL BPA OF THE

Biological Photographic Association

Dedicated to the Science and Techniques
Pertaining to the Photography of All
Things Which Live or Which Have Lived

QUARTERLY OF THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION, INC.

Volume 23, Number 1 February, 1955

JOURNAL *of the* BIOLOGICAL PHOTOGRAPHIC ASSOCIATION

EDITOR • LLOYD E. VARDEN, F.B.P.A., F.P.S.A., F.R.P.S.
A-1105 200 East 66th Street, New York 21, New York

EDITORIAL BOARD

Dr. Edmond J. Farris, The Wistar Institute, Philadelphia, Pa.
Dr. Arthur W. Proetz, 12 Westmoreland Place, St. Louis 8, Mo.
Dr. Oscar W. Richards, American Optical Company, Southbridge, Mass.
Lewis W. Koster, 630 W. 168th Street, New York 32, N.Y.

OFFICERS OF THE ASSOCIATION

President — Warren Sturgis, Sturgis-Grant Productions, Inc., 322 East 44th Street, New York 17, N.Y.

Vice President — H. Lou Gibson, Eastman Kodak Company, 343 State Street, Rochester 4, N.Y.

Secretary — Jane H. Waters, Grand Central P.O. Box No. 1668, New York 17, N.Y.

Treasurer — Albert Levin, Photographic Department, Magee Hospital, Pittsburgh 13, Pa.

EDITORIAL POLICY

Manuscripts should be sent to the Editor in legible form, preferably typewritten, double spaced, with wide margins. Tables should be given on separate sheets, each with self explanatory captions. Give references separately, numbered according to reference notations in the manuscript. References should include, where applicable, article or book title, author(s), volume and number or edition, page number(s), plublisher, month and year.

Illustrations should accompany manuscript, preferably unmounted. Give legends separately, clearly identified. Illustrations should be of proper dimensions to fit single column, double column or full page of the Journal.

The editors reserve the right to reject manuscripts considered unsuitable. Major alterations of accepted manuscripts will not be made without permission of the author(s).

Special Note: If you have an idea or technique of importance to biological photography and need assistance in preparing manuscript, write Editor.

Opinions expressed by authors are not necessarily those of the Biological Photographic Association.
Copyright, 1955, by Biological Photographic Association, Inc.

OFFICIAL PUBLICATION OF THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION, INC.

Published at 733 North Van Buren Street, Milwaukee 2, Wisconsin. Editorial office: A-1105, 200 E. 66th Street, New York 21, N.Y. Entered at the Post Office, Milwaukee, Wisconsin, under the act of March 3, 1879. Subscription price $6.00 per volume; foreign $6.50. Single copies $1.50 in the U.S.A.; foreign $1.65 in U.S.A. funds.

Journal of the Biological Photographic Association Vol. 23, No. 1 February, 1955

Photography of Surgical and Research Apparatus*

LARDNER A. COFFEY

Section of Photography, Mayo Clinic, Rochester, Minnesota.

THE medical photographer frequently is requested to photograph apparatus and equipment that are the products of medical research. The problems encountered are diverse and are unlike those encountered in routine medical photography. Success in photography of apparatus is dependent upon proper illumination of the object, careful selection of the background and correct positioning of the object in relation to the camera angle. Careful attention to these three factors will produce a photograph that accurately and clearly records all important parts of the object.

Position of Object

The position or pose of the object should be determined first, preferably with the physician or research worker present, so that the photographer clearly understands the important parts to be shown. The object can then be placed to make the important parts clearly visible. If it is a simple, straight surgical instrument, the best position is one with the camera axis at right angles to the instrument. Other objects, however, may necessitate a different view to demonstrate size, depth or a special feature, or to create a three-dimensional effect. Perhaps several photographs taken with the object in different positions will be necessary. A framing viewer is helpful as an aid in positioning. This viewer can be a cardboard mask with a rectangular opening about 2 inches by 3 inches in size. It is best used approximately 1 foot from the viewer's eye. When the object is viewed through it, all extraneous objects are masked out and the best position of the subject is easily determined. The best viewing position frequently is one that shows three sides of the object: the front, top and either left or right side. A cube or box when photographed to show only the front appears as a flat square surface, but when the camera angle is changed to show three sides the cube takes on its true appearance. It has then not only width and height, but also depth — the photographer has created a three-dimensional effect. The object may be best posed by placing it upon a flat surface, as a tabletop, or by supporting it with a laboratory stand and clamp. Modeling clay is very useful if the object must be held in a fixed position. The mitral-valve instruments in Figure 1 were supported with a small piece of clay placed under the handles. Frequently it is helpful to include a metric scale in the picture. This is especially true if the object is small, for the scale serves as a basis on which an estimate of the size of the object can be made.

*Presented at the 24th Annual Meeting, Atlantic City, 1954.
Received for publication August 23, 1954.

Background

The proper background will insure a successful photograph by producing adequate separation between it and the object. If the object is dark it will stand out clearly against a white or light background, but the reverse is true if the object is light. Frequently, the tone ranges from light to dark so that a background that produces a neutral gray tone in the finished picture is preferable. This can be secured by using gray or colored cardboard. Light-green or red colors used with orthochromatic film will produce the best gray tone. The background material should be free of pattern or pronounced texture that will be distracting in the final photograph. This is particularly true if the object is small, for the camera will be close to the background, thus emphasizing any texture. Cardboard background material that is free of texture or pattern can be purchased at most stationery supply stores, or if none is available the texture can be minimized by placing the cardboard well back of the object. Background paper is also available in large rolls in a variety of colors and shades. This paper background is very useful when large objects are photographed. A large piece can be used upon the floor and then curved up and fastened upon the wall to form a continuous background. This technic eliminates a distracting horizon line or separation line between the floor and background. The same technic can be used when smaller objects are photographed.

Occasionally the photographer does not have proper background material available. One solution, then, is to place a cloth background, such as a bed sheet, back of the object. Then the sheet is kept constantly in motion during the exposure, this motion producing waves across the sheet. If the exposure time is 30 seconds or longer, this technic will produce a background free of wrinkles, folds or texture. On other occasions when a large apparatus, such as an operating room table, is to be photographed one solution is to use a plain wall as a background. Frequently the equipment will have to be shifted or moved to another location to secure a wall surface free of distracting obstructions.

Illumination

Proper illumination is an important factor in securing maximal detail in the finished picture. Generally the photographer will secure more satisfactory results if diffused light is used and the picture is kept free of harsh shadows that hide detail. If shadows are necessary to depict the shape or form of the object, they should be kept soft and transparent.

An object of high reflectance requires soft, well-placed illumination. Frequently the position for the lights is very limited — so much so that the correct position can be determined best by observing the effect upon the ground glass of the camera while the lights are placed in different positions by an assistant. It is not uncommon to observe that a slight shift in the position of the light entirely alters the effect. Reflections upon metal or glass objects can be used to advantage, but if improperly placed they will eliminate detail. Photography of objects of high reflectance is primarily a matter of well-placed diffuse illumination. Conversely, objects of low reflectance offer the photographer a wider range of light placement, and thus they are much easier to record properly. Large pieces of ap-

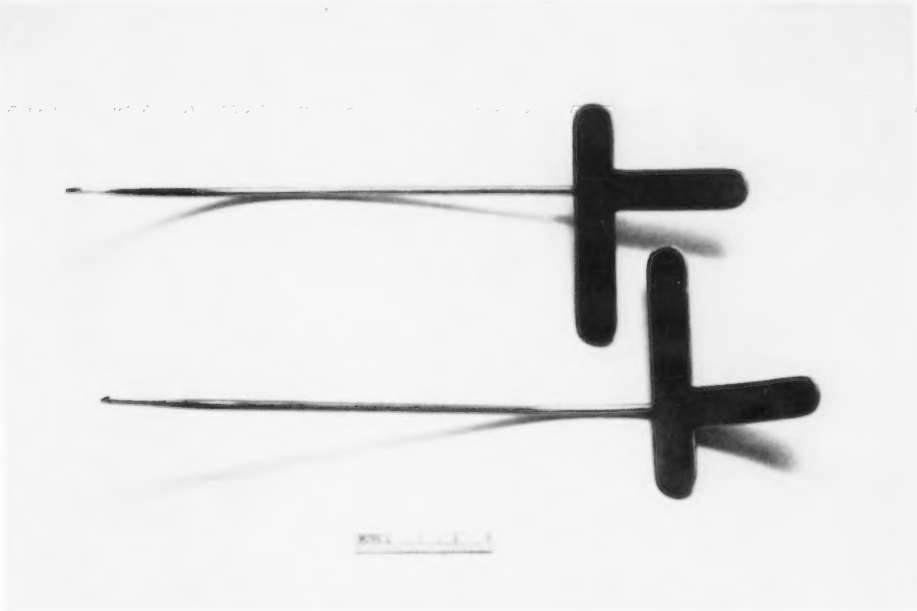


Figure 1. The shadows of these mitral-valve instruments upon the background indicate that the instruments are curved. The instruments were supported with a small piece of modeling clay under each handle.

paratus should be lighted to avoid distracting shadows upon the background. This can be accomplished by placing the apparatus 3 or 4 feet from the background and the lights at a high, side angle — one on each side at different distances.

The size of the image also will determine the amount of detail visible in the finished picture. The larger the object the less will fine detail be discernible. Often this must be explained to the client, preferably before the picture is made. The cutting tips of the mitral-valve instruments in Figure 1 could be shown in detail only by taking a close-up picture of the cutting tip itself.

Proper illumination also insures good separation between the object and the background. Shadowless lighting is often the most convenient method of achieving this goal. It can be obtained by photographing the object upon an illumination box. Detail on the front surfaces is obtained by overhead illumination while transmitted light from the illuminating box is used to eliminate shadows and produce a white background. The objects in Figure 2 were photographed in this manner with the aid of overhead tent lighting. The tent was made by fastening a bed sheet around illuminating box and camera. Lights were directed at a 45° angle on each side of the instruments. This produced even illumination upon each instrument, while other positions caused glaring reflections. The white background is produced by the transmitted light of the illuminating box. Frequently the beveled or curved surfaces of an instrument reflect the transmitted light so intensely that these surfaces blend with the background. This was true

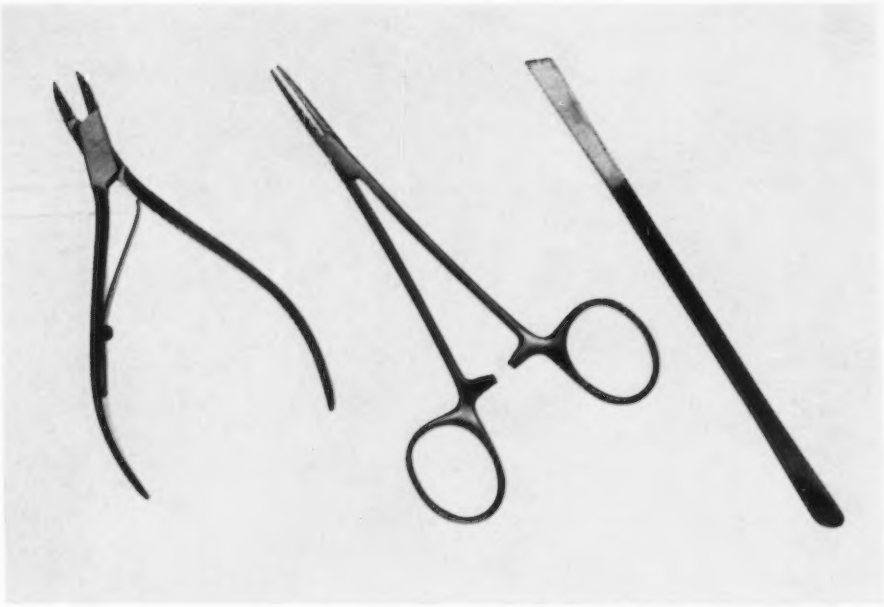


Figure 2. These instruments were photographed with the transillumination of a light box producing the white background. Overhead tent illumination was used to secure surface detail.

of the beveled cutting tip of the clippers. These reflections were eliminated by placing two black pieces of cardboard upon an opal glass 2 inches below the instruments. The instruments rest upon clear plate glass situated above the opal glass. The cardboard formed a corner at the tip of the clippers just outside the picture area.

Similar results can be secured without tent illumination by directing a single source of light at the ceiling. During exposure the light is moved constantly in an arc of approximately 90° at a distance of 5 feet beyond the upper edge of the picture. Other positions create glaring reflections upon the instruments.

The same objects were photographed against a black card with the aid of tent illumination (Fig. 3). This time light was used at each corner to obtain illumination that would separate the instruments from the background. Notice, however, that reflections could not be obtained upon the beveled cutting tip of the clippers. Retouching with pencil and dye upon the negative would be necessary to delineate these surfaces.

Excellent illumination can be secured by using one light source reflected from a white card. If the light and card are hand-held, the two can be moved during the exposure to secure evenly distributed illumination (Fig. 4). In this instance the backgrounds were secured in the following manner: in Figure 4*a*, with a black card; in Figure 4*b*, with a white card; and in Figure 4*c*, with the illuminating box. Notice that when the black background is used the edges and tip of the instrument blend with the background, so that the instrument appears narrow and the tip is not accurately recorded. When this kind of object is photographed against a black

Figure 3. The same objects as seen in figure 2 photographed upon a black background. Notice that the light could not be placed at an angle low enough to produce reflections upon the beveled cutting tips; thus they blend with the background.

background it is impossible to place the reflections low enough to separate the instrument and background. The photograph made with a white card (Fig. 4*b*) is an improvement, but again the edges of the instrument tend to blend with the background, the blending being caused by reflections of the white background. The most accurate portrayal is the picture made with the illuminating box (Fig. 4*c*) and sufficient top light to record detail and still separate the instrument from the background.

Not all objects can be demonstrated to best advantage with shadowless lighting. An earpiece, used to measure blood pressure (Fig. 5), was photographed upon a white card. One light was used and it was placed close to the camera lens. A white cardboard reflector was placed as low as possible on the shadow side. It was located immediately outside the picture area, and produced a reflection upon the earpiece, separating it from the background.

The mitral-valve instruments (Fig. 1) were photographed in much the same manner. The instruments would not have appeared curved had shadowless lighting been employed.

Glass objects are difficult to photograph[1]. A Friedrich condenser, when illuminated in the conventional manner (Fig. 6*a*), displays a multitude of reflections that hide the details of the object. If the condenser is sidelighted and backlighted the result is very different and a far superior picture is secured (Fig. 6*b*).

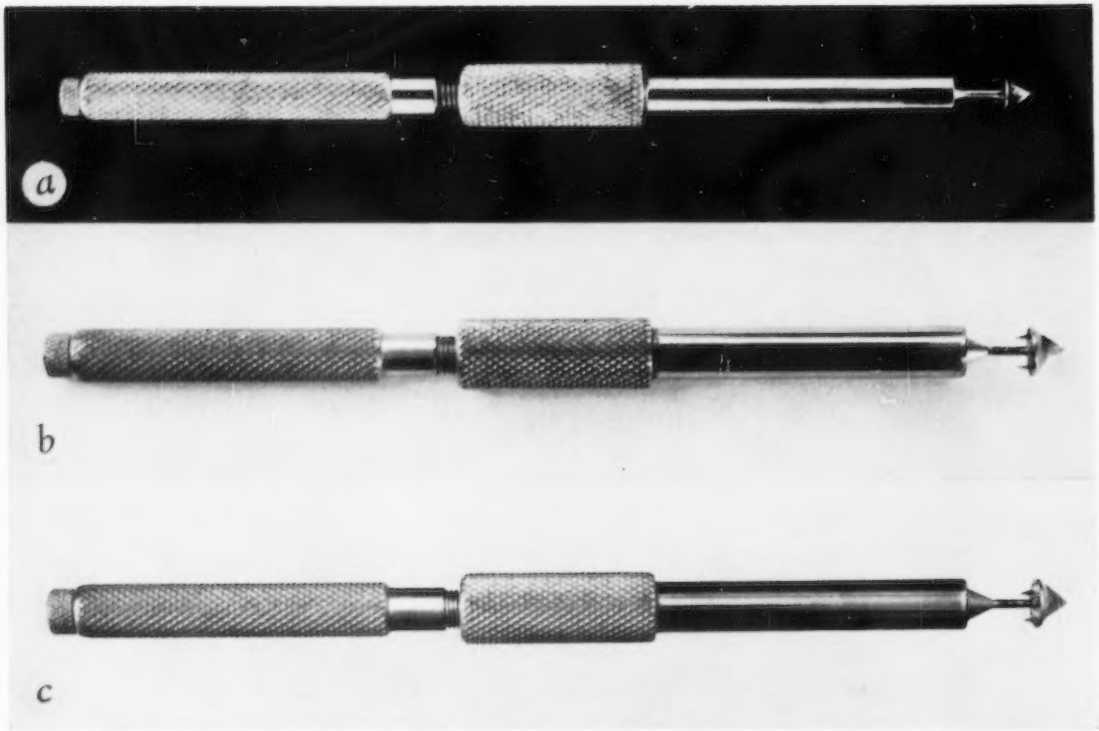


Figure 4. This heart-punch instrument was photographed in each picture with moving light produced by reflecting the light against a white card. In (a) the background was black. Notice that the tip and edges of the tube blend with the background. In (b) the instrument was placed upon a white card. This picture is an improvement but this time the edges of the tube merge into the white background. In (c) the background was secured with an illumination box.

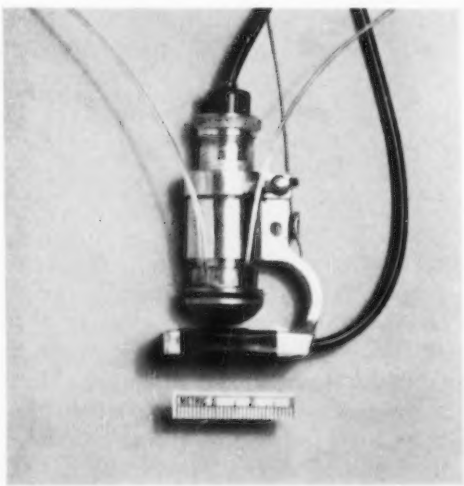


Figure 5. This instrument was illuminated with one diffused source of light. A white reflector was placed low and to the left of the picture. The metric scale serves as a basis on which the size of the instrument can be estimated.

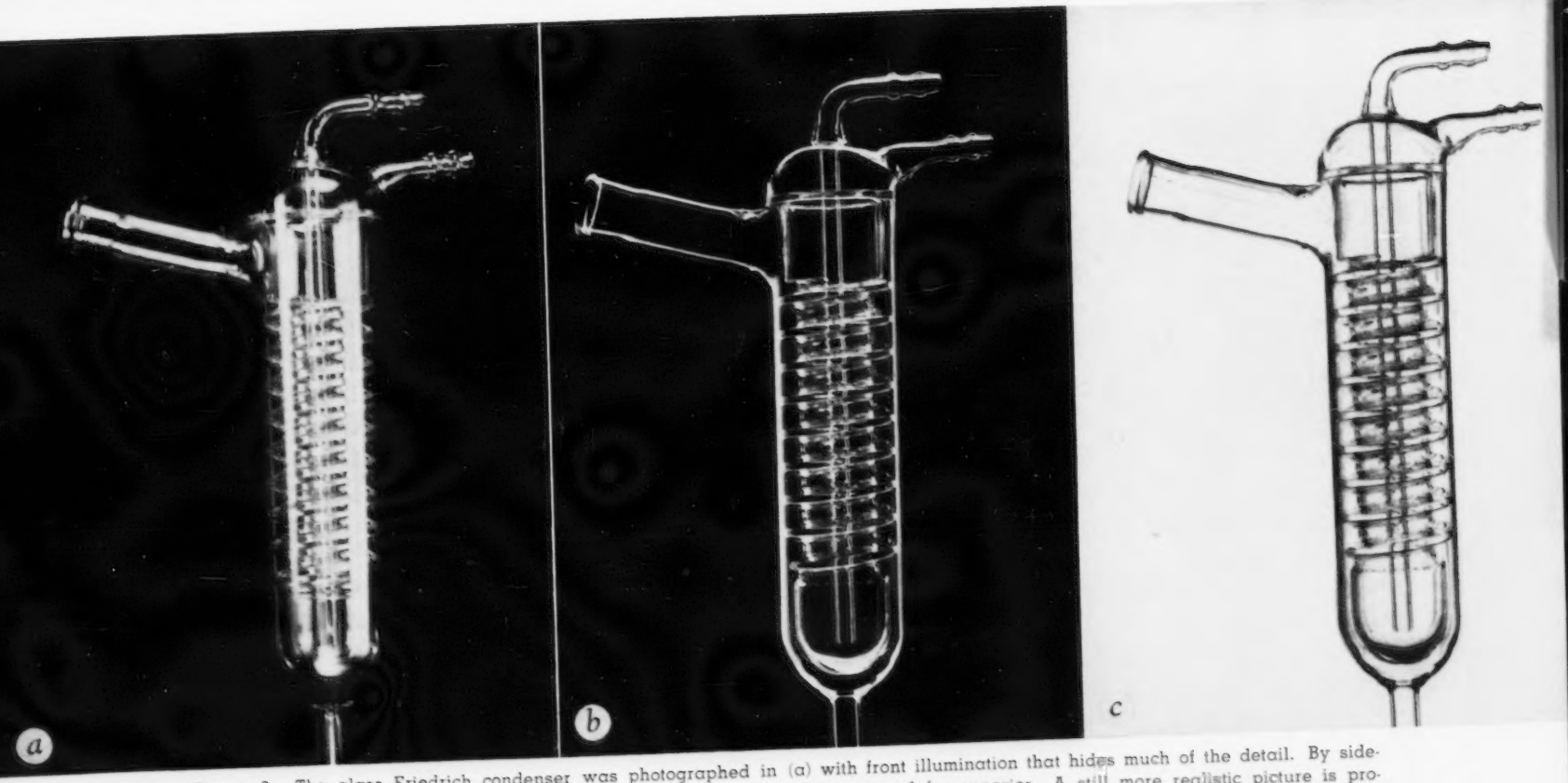


Figure 6. The glass Friedrich condenser was photographed in (a) with front illumination that hides much of the detail. By side-lighting and backlighting the condenser, in (b), the effect is much different and far superior. A still more realistic picture is produced, in (c), by using a negative picture made from an intermediate positive transparency.

Excellent lighting can be obtained by supporting the condenser in front of a north window (Fig. 7). A black card, slightly larger than the condenser, serves as a background. It also permits daylight to pass around it, thus illuminating the condenser. Another black card placed above the background card is used to eliminate some overhead light, thus producing better balanced illumination. All parts are edged with light, which gives a relief appearance (Fig. 6*b*). The photograph is more realistic if a negative picture is used (Fig. 6*c*). This negative photograph is printed from an intermediate transparency which was made from the original negative film.

An adaptation of this technic is to edge-light the glass object evenly with diffuse incandescent illumination. The apparatus is placed upon a sheet of plate glass, and the background placed either below or behind it depending upon the camera angle. The main source of illumination should be at the sides. If the object is tall or long this lighting may be best done with a moving light reflected against a white card. Additional illumination from above and below can be added to delineate curved surfaces that will show third dimension.

Some plastic materials such as methyl methacrylate (*Lucite*), although resembling glass, are not as difficult to photograph. The cut and scored surfaces of such material will catch and reflect the light as in Figure 8, thus outlining the edges of the apparatus. In this illustration, bare photoflood light was used at each side. Such objects with curved surfaces are more difficult to handle, but they do not present the pitfalls of glass material.

Daylight also can be used advantageously when large objects are being photographed. Roentgen-ray equipment and an orthopedic fracture table (Fig. 9) were photographed in an operating room illuminated by a north skylight. Light from No. 4 photoflood lamps was used in conjunction with the daylight, the daylight serving as fill-in light. A satisfactory photograph could have been made with the aid of artificial light alone, but the task would have been considerably more difficult.

Fluorescent light as used in many laboratories is a good main source of illumi-

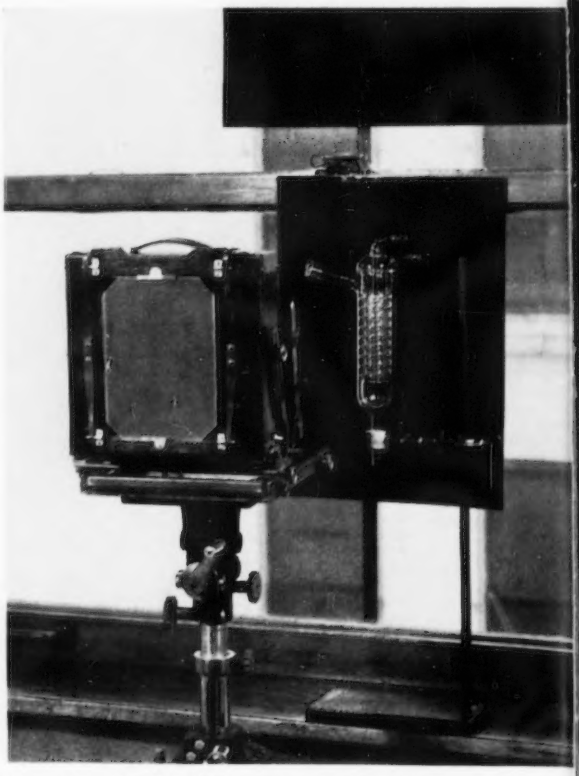


Figure 7. The Friedrich condenser was photographed as illustrated. The black cardboard behind the condenser served as a background and at the same time allowed daylight to fall upon the condenser, producing the photograph seen in figure 6(b). The black card situated above the object eliminated some of the intense overhead daylight.

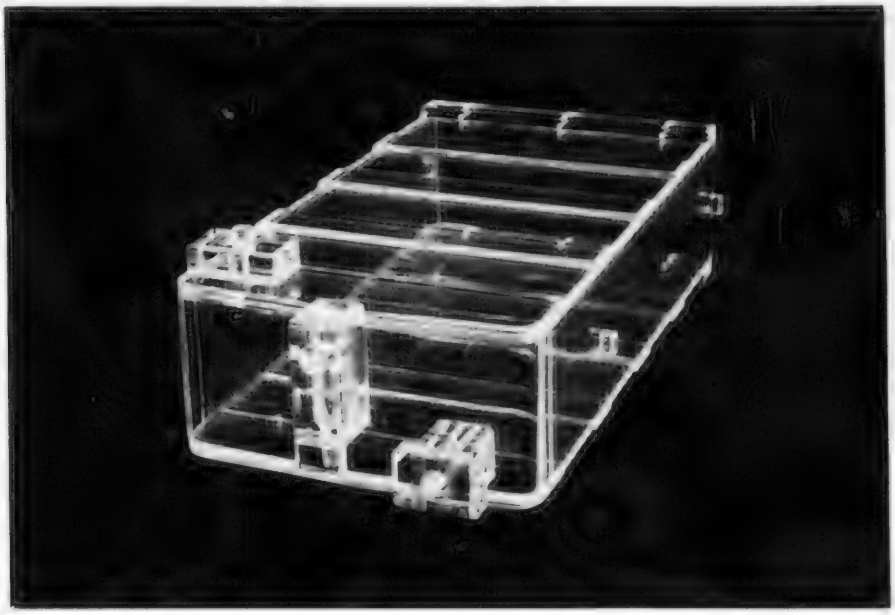


Figure 8. The cut edges and scored surfaces of this box made of methyl methacrylate (*Lucite*) catch and reflect light. This makes it easily photographed. The box was illuminated with bare photoflood light placed at each side.

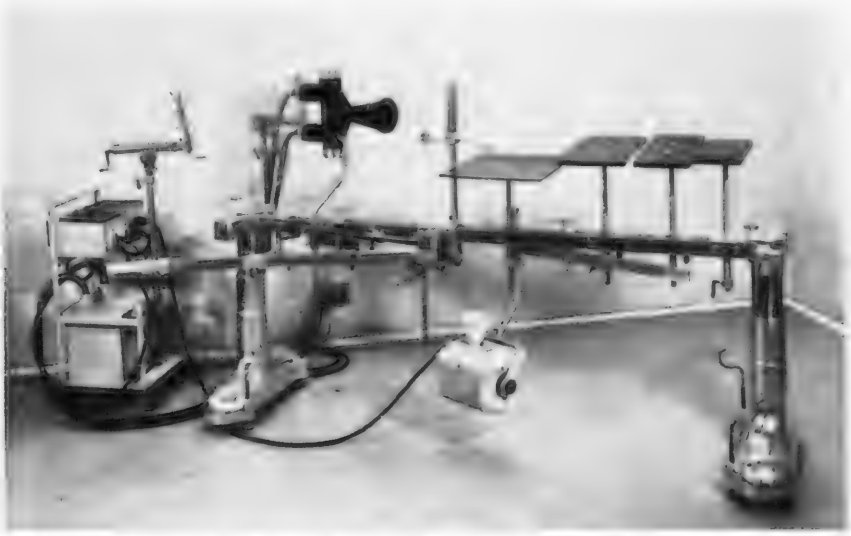


Figure 9. Daylight from the north skylight of the operating room and artificial illumination were used to secure this picture of X-ray equipment as it is used upon an orthopedic fracture table. (Reproduced with permission from: Runge, R. K., Kirklin, B. R. and Ghormley, R. K. Roentgenologic Apparatus Attachable to the Bell Fracture Table. J.A.M.A. 146:1026-1028 [July 14] 1951

Figure 10. This photograph was made at a high camera angle to show the relationship of the patient, the physician-anesthetist, and the equipment.

nation and frequently can be used as the only source. Like skylight illumination, fluorescent light produces soft shadows so that all detail is clearly depicted

When several large objects are to be included in a photograph, it is frequently difficult to show all aspects of them. The best picture can then be made from a high camera angle, as illustrated in Figure 10. This photograph, taken in cramped quarters, was made not only to show the patient, the physician-anesthetist and the automatic anesthesia equipment, but also to portray the position and relationship of each in the operating room

Photographic Equipment

It is often said that the photograph will not be better than the lens that was used to take it. It is important to have a maximal amount of detail in the finished photograph, and this can be assured if a high quality lens is used The lens should be of normal focal length, as is used for other medical photography. This with a wide-angle lens will meet most working requirements. The photograph of the automatic anesthesia equipment (Fig. 10) was made with the camera as far as possible from the equipment and with a wide-angle lens. The high camera angle

necessitated sacrificing perspective. Occasionally a lens of long focal length can be used to secure proper perspective-size relationships. If a lens of long focal length is not available, the same correct perspective can be secured by placing the camera farther from the object. This reduces the size of the image, but an enlarged print will produce the desired result. Perspective is a matter of object-lens distance, with the lens determining the size of the image.

The camera should be of the view type. It should have a double extension bellows which is necessary for close work, and a large lens board that will accommodate different lenses. A camera with rising and falling front, and rear swing and tilt adjustments is extremely useful, for these features can be used to correct perspective and retain sharp focus. In contrast, the miniature camera does not fulfill these requirements.

The tripod should be sturdy and firm, and capable of vertical positioning of the camera. A type with a horizontal extension arm permits placement of the object so that the tripod legs do not interfere. The adjustments should be easy to handle and so constructed that the camera height can be readily changed.

Summary

A successful photograph of medical apparatus or equipment must clearly record all parts of the object and show all important detail in it. This can be accomplished by: careful attention to the position of the object or the choice of camera angle, often both; proper illumination of the object; and the choice of background material. None of these factors is sufficient alone. All must be employed if good pictures of medical apparatus and equipment are to be produced.

REFERENCE

Schmidt, Louis and Haulenbeek, J. B.: The Photography of Glass Apparatus. J. Biol. Photo [illegible]

A New 35mm Technical Camera*

PETER HANSELL

Departments of Medical Photography and Illustration,
Westminster Medical School and Institute of Ophthalmology, London.

Introduction

THE following brief description of a new 35mm technical camera may be of some interest. It was devised by the author in close association with C. E. Engel of Guy's Hospital and Kennedy Instruments, Ltd.† of London.

With the increasing popularity and established economy of 35mm colour photography, a need was felt for a technical or view-type camera possessing features which were found to be lacking in all the well-known precision miniature cameras, despite their range of [illegible].

Engel[1] has already described a system of medical photography which features the prototype of the present camera.

Description

A general impression of the camera in a contorted position may be gained from Figure 1. The component parts are displayed in Figure 2, and attention is drawn to the following points:

(a) The basic support is a pan/tilt head for tripod fitting, through which passes a rigid monobar calibrated in millimeters for the purpose of establishing scale.

(b) Two identical brackets support the camera proper. These carry the lens panel at the front, and the focusing screen and film magazine at the rear. Between them is suspended a detachable bellows. Each bracket endows the front and back of the camera with the following movements: (i) 1½ inch of rise. Extreme positions of rise and fall are achieved by inclining the monobar itself and returning the front and back panels to a vertical position by tilting. (ii) Full horizontal and vertical swings. The back which carries the 35mm film magazine can further be rotated through 360°.

(c) Each entire bracket, when suitably positioned, may be moved independently on the monobar by control knobs, or alternatively, if working to a definite scale at a fixed extension, the whole camera may be moved to and fro by means of the control at the centre support. The remaining knobs to be seen in the illustrations are for locking the various movements. Conveniently placed graduations indicate when these are in a "zero" position.

(d) Interchangeability and unit construction make it possible to use a monorail and bellows of any length to suit the task in hand and the particular lens in use.

(e) Focusing is achieved by means of a ground glass screen which is well hooded and is provided with an adjustable field lens giving a magnified view of the picture area: this lens may be removed if desired.

*Received for publication September 7, 1954.
†Kennedy Instruments, Ltd., 12a, Weir Road, Balham, London, S.W.12.

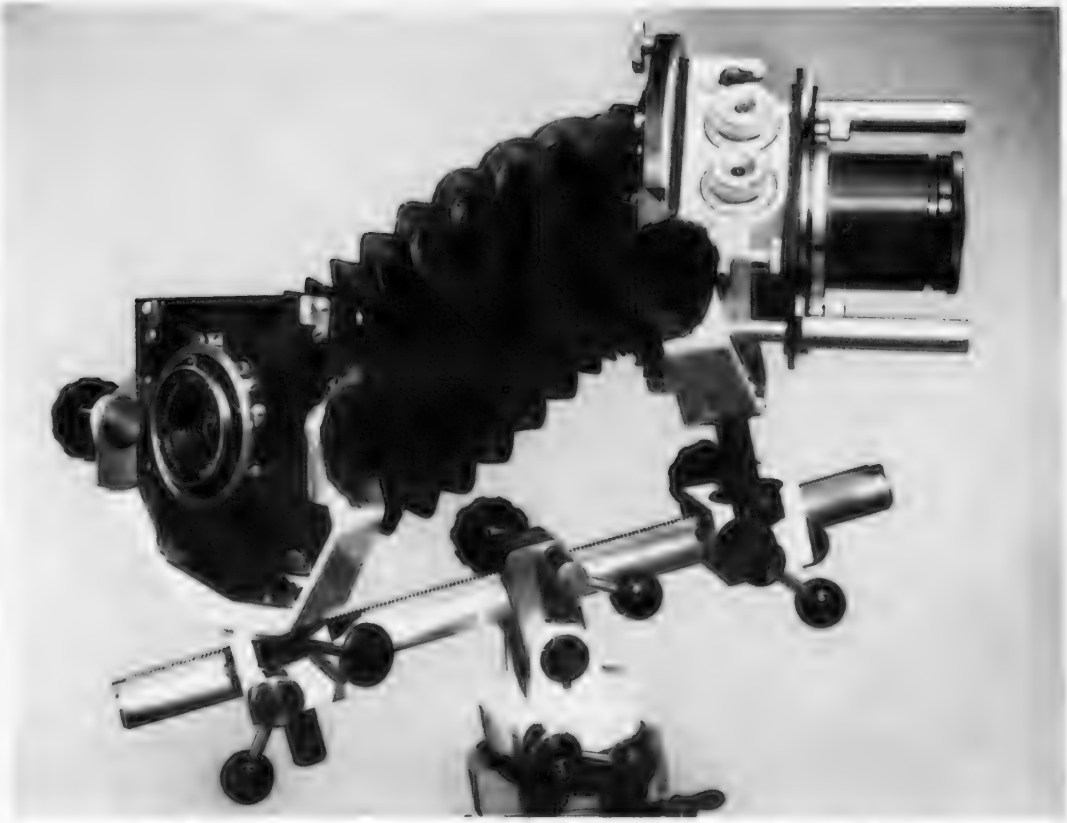


Figure 1. Complete 35mm monobar camera showing some of the possible movements

Figure 2. Individual components of the camera assembly.

Figure 3. Film magazine separated for loading. When the back is removed from the camera, the film is protected by a dark slide

Figure 4. Four inch x five inch and 35mm cameras mounted for parallel operation.

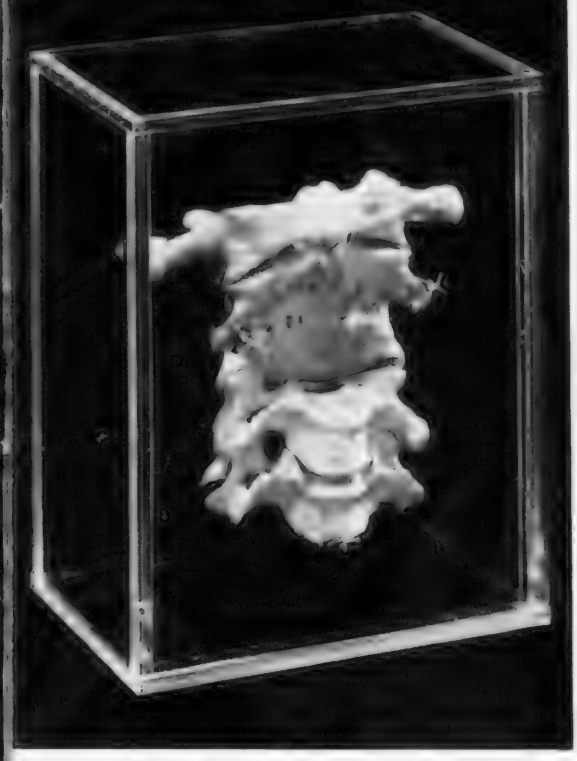


Figure 5. Corrective photography pathological specimen mounted in *Perspex* container

Figure 6. Close-up photography conjunctival vessels X24

(f) Interchangeable film magazines which accept conventional 35mm cassettes enable identical pictures to be made rapidly on different film stocks. Each magazine has a mechanical dark slide which is operated by a knob on the back face. Figure 3 shows a single magazine in detail.

(g) In effect this is a scaled down version of the familiar view camera. Used in a straightforward manner, it possesses certain advantages for rapid work in diverse conditions. For example, using a 5 inch lens, it is possible to focus continuously from infinity to 5 inches, the latter position giving a magnification of one on the negative, when using the standard bellows. Lenses of shorter focal length, and having helical focusing mounts, may be accommodated directly on the rear panel of the camera; in this event, the bellows and the complete front bracket are removed.

In a sense, this paper must be regarded as a preliminary communication, for although developed for medical work, it is felt that such a camera has application in other branches of photography and it is not difficult to conceive additional features which may be incorporated in the design. In practice, the camera has proved most flexible and it can, if desired, be mounted and operated in tandem with larger equipment (Fig. 4).

Acknowledgment

I should like to acknowledge the help of my staff and colleagues in the preparation of this paper.

1. Engel, C. E., 35mm Reversal Material in Medical Photography. Medical and Biological Illustration, 4, No. 1, pp. 12-19 (1954).

Journal of the Biological Photographic Association Vol. 23, No. 1 February, 1955

Stereoscopic Photomicrography with Cameras of Fixed Interocular Distance*

HENRY M. LESTER
New York City
and
OSCAR W. RICHARDS
American Optical Co., Southbridge, Mass.

MAGNIFIED three-dimensional photographs of small objects are of considerable interest to science and industry. Two pictures of the specimen are essential, each representing a slightly different aspect of the subject. Various methods have been used. Lester proposed simplifying the technic through the use of cameras with fixed interocular distance employing 35mm film, such as the *Stereo Realist*, which make the two required pictures simultaneously. The ready availability of standard mounts and viewers for such stereo pairs make their handling and viewing simple and effective.

(1) Binocular Biobjective Microscopes

The binocular biobjective microscope or the Greenough stereoscopic microscope is the logical choice when high magnification is not required. This microscope is a true stereo instrument, being a combination of two complete microscopes mounted side by side, moving as one upon a single stand. Each eye views the specimen through its own microscope. A further advantage is seen in Figure 1, showing the path of light through this type of instrument, in that the Porro prisms invert the image, so that it is seen right side up. The disadvantage of this type of microscope is that its resolving power is limited, because the two objectives cannot be brought very close together without interfering. The mechanical limitation restricts the numerical aperture to about 0.12; consequently, there is no advantage in employing this type of microscope for magnifications exceeding 100 diameters. However, most applications of the Greenough microscope do not require magnifications outside of range of 5 to 50 times.

The axes of the oculars in the stereoscopic microscope usually converge towards the specimen. The angles of convergence of the ocular tubes and of the objectives determine the appearance of depth in the stereoscopic view of the subject. In some makes of microscopes these two angles are the same and the object is seen in correct perspective. In other makes, the appearance of depth has been increased to facilitate manipulation in such applications as microsurgery. Table I lists the convergence angles of some popular microscopes.

*Presented at the 24th Annual Meeting, Atlantic City, August 1954
*Received for publication September 11, 1954

Table I.

Prisms Required for Stereoscopic Photomicrography with Some Popular Microscopes

Microscope	*Included Angle Objectives*	*Eyepieces*	*Prism (Diopters)*
(A) Biobjective Binocular (Greenough)			
AO-Spencer	12	8	7.0
Bausch & Lomb	10	10	9.0
Leitz (straight eyepieces)	18	16	14.0
Leitz (inclined eyepieces)		—	*
Zeiss X		8	7.0
Zeiss XII		5	4.0
(B) Monobjective binocular:			
AO-Spencer (inclined eyepieces)	—	8	7.0

Microscopes with parallel (straight) eyepieces require no prisms

* Varying from 8.5° at 54mm interocular distance to 18° at 76mm. Prisms required would be of power corresponding to angle of inclination at camera interocular distance, e.g., for *Realist*, 70mm — use 13.5 diopter prism

Figure 1. Light path through binocular biobjective microscope with straight eyepieces and prisms to invert the light beam to give an erect image.

One of the requirements of stereo photomicrography with cameras having a fixed interocular distance is that the rays of light emerging from the microscope oculars be parallel or nearly so, to permit their entry into the two camera lenses along their respective axes. To turn the diverging rays of light emerging from the oculars of the stereoscopic microscope into the camera lenses two ophthalmic prisms are employed, with their bases towards each other. The power of the prisms will vary for any given make of microscope with the angle of convergence of the oculars as shown in Table I. The power of the prisms is obtained by dividing the tangent of the angle of inclination from the vertical by 0.01. The prisms are secured to the camera lenses in simple slip-on mounts, which are provided with reference marks on their outer rims for proper orienta-

tion and accurate alignment, easily accomplished with a small straightedge. (Figures 2 and 3.)

The prisms should be mounted as near as possible to the front element of the camera lenses so that the exit pupil of the microscope ocular (Ramsden disc) be close to or within the front lens of the camera. When the camera is centered over the properly focused microscope, a single exposure will produce simultaneously a photograph of the image emerging from each of the two microscope oculars, the pair to be later viewed as a true stereoscopic view of the magnified subject. (Fig. 4)

Prisms of ophthalmic quality are satisfactory for ordinary stereo photomicrographs, although it is realized that for most critical work, color corrected prisms may be required, or some other method used for making the pair of views. When the camera lens becomes a part of the optical system, some deterioration of the final image may take place, unless the camera lens is as good as the optical system of the microscope. For practical purposes, this may not be objectionable.

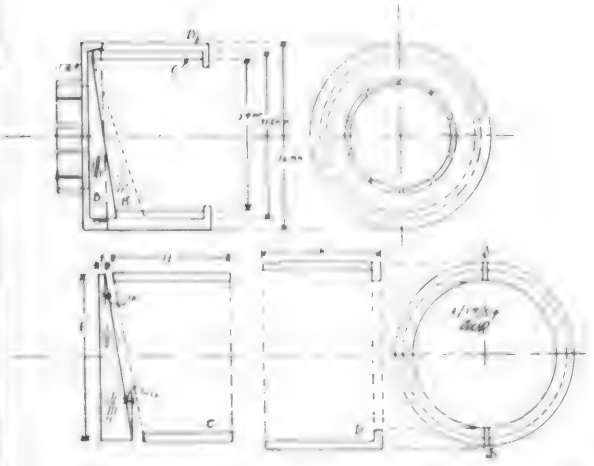


Figure 2 Slip-on prism mount for lenses of 35mm Stereo Realist camera. A slip-on collar, BB': prisms, C prism retaining ring, D: outer retaining ring forming light trap for microscope oculars, LM: reference marks for alignment of mounts on camera.

A stand to support the camera in proper alignment with the microscope is desirable, even though it is entirely possible to take the pictures with hand-held camera. The stand should have some provisions for swinging or tilting the camera to and from the microscope to allow for its manipulation between exposures. The set-up also should make provisions for re-establishment of the camera alignment with ease and certainty. Figure 5 shows a stand assembled from the light-weight rods, clamps and brackets of the *Flexaframe Laboratory Stand System* (Fisher Scientific Company). Figure 6 shows another method of camera suspension made up from a laboratory stand which has a wide horseshoe base (18 inches of open working space) with an upright $\frac{3}{4}$ inch in diameter. A slider supports an arm to which is connected a fork-shaped shelf. (Fig 7): the camera rests upon it securely, the lenses nesting snugly between the two tines. The camera can be easily lifted out for loading or unloading the film, or other uses. A camera support can also be made from an adaptation of an enlarger base and upright.

Each microscope objective has a definite magnification and depth of field. The choice of the objective should be made bearing in mind that over-all sharpness and great depth of field are important requirements of stereo photography: best results are ordinarily secured with the lowest power which gives adequate rather than excessive magnification of detail. Stereo pictures will be more pleasing when the top of the specimen (point nearest the objective) is in good focus. A little loss of good focus away from the observer is generally less ob-

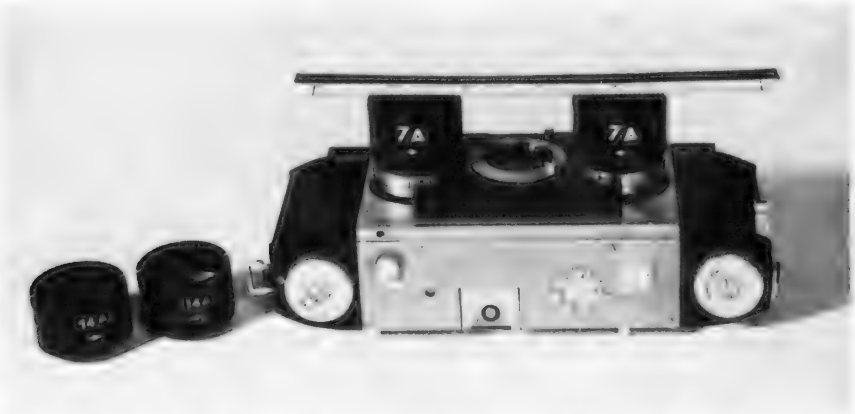


Figure 3. Stereo Realist camera with mounts aligned by a straight edge. Another pair is shown with 14△ prisms.

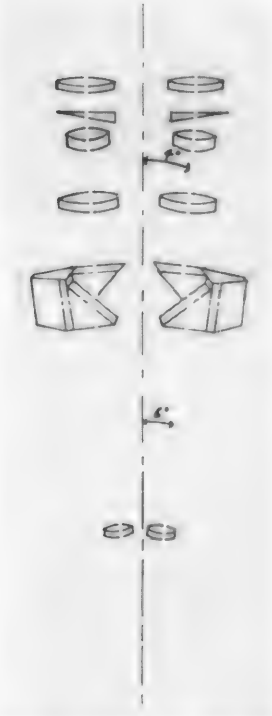


Figure 4. Light path through stereoscopic microscope with 6° objective and 4° ocular convergence. Prisms between oculars and camera lenses turn light beams parallel for entrance into the camera lenses.

jectionable than towards the observer. However, the "in" or "out of" focus aspects of stereo photography are within the province of personal criteria: what might be satisfactory to one person or application, may not be acceptable to another.

Focusing the Microscope for the Camera

The stereo camera with a fixed interocular distance between its lenses, as employed here, should have both lenses set to infinity, which setting should be secured with a bit of adhesive tape. Since the image-forming rays from the microscope ocular are substantially parallel, the camera lens, placed close to the ocular, will form an image from such rays in its film plane when it is focused for infinity. The image on film will usually appear with a sharply outlined circle under such conditions, and the diameter of the circular outline will be larger as the magnifying power of the microscope ocular increases.

When the camera lens is used in this manner, the stated magnification of the microscope ocular is reduced. In the

Figure 5 Microscope and camera stand made from Flexaframe Laboratory Stand arranged for stereo photomicrography

about 35mm. this reduction amounts to about 1/7th of the nominal magnification. Thus, an ocular having a nominal magnification of 15X will produce, on film, an effective magnification of a little over 2X. This loss of magnification on film is largely restored in the viewer.

There is no gain from stopping down the camera lens aperture more than one stop from its largest opening; no greater depth of field will be obtained. To avoid vignetting, the camera lens diaphragm should be left open enough so that it will not restrict the cone of light from the microscope ocular.

The microscope should be in proper adjustment before stereo photomicrographs are made. A simple method of testing this is to focus the instrument on a ruler or some other object having straight lines or edges. When this is placed at the right outside edge of the field, it should be seen in the same position by each of the two eyes. Similarly, the top and bottom of the field should be checked for like position of the subject within the two fields. Though centering screws are provided for the alignment of the objectives, any necessary adjustments should be made only by those familiar with this procedure, by the maker of the microscope, or a competent repairman.

If the nature of the specimen is such that its top and bottom or its right or left side are significant for its identification or recognition, then the stereo camera should be suitably oriented above the microscope. Its top should coincide with the top of the image of the specimen. This is an important requirement for good stereo photomicrography that should never be overlooked. This may also be accomplished by putting the preparation on the stage so that its top is in the direction of the top of the camera.

Lighting the Specimen

It must be remembered that one is providing illumination for a subject to be seen from two viewpoints, each from a slightly different angle. Unless the light source is relatively large, the mirror may not provide illumination adequate for evenly lighting a transparent specimen to be viewed at low magnification from two different directions. Placing a piece of thin white paper or a piece of opal glass over the mirror may diffuse the light enough to illuminate both sides of the microscope for this type of specimen. A corresponding reduction of light intensity must be taken into account when calculating exposure.

(2) Binocular Monobjective Microscope

The binocular microscope having a single objective is not a true stereoscopic instrument, but various means are available to adapt it to the needs of stereo observation and stereo photomicrography. The light gathered by the single

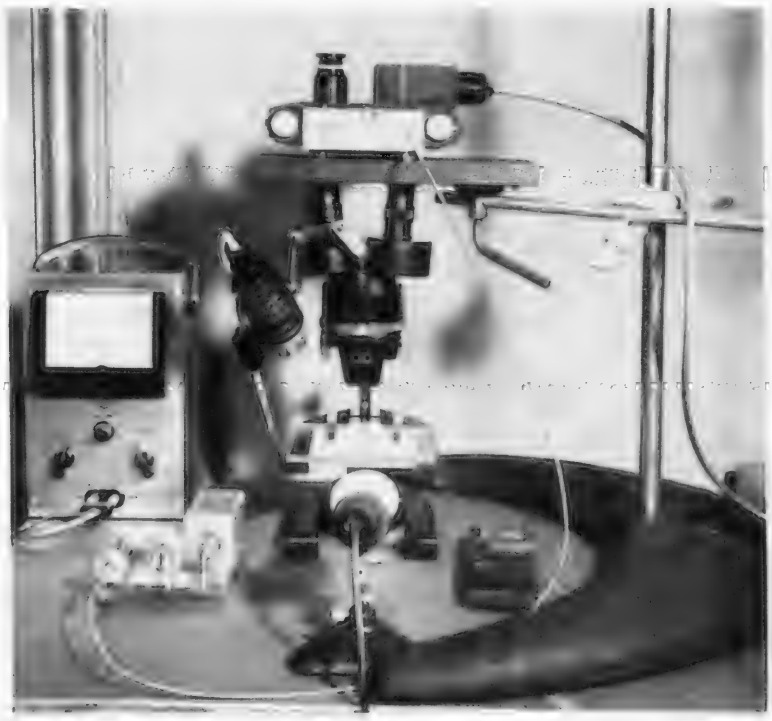


Figure 6. Laboratory stand with wide horseshoe base and ¾ inch upright supporting Stereo Realist camera on U-shaped shelf (see Fig. 7). Light meter probe and magnifier are shown on ground glass inserted into camera after camera back is removed.

objective is divided equally between th two eyepieces, transmitting to each [illegible] the identical view of the subject at nearly one-half of its brightness (Figure 8). No perception of depth is available, unless special provisions are made.

Right and left eye views may be secured through the right or through th left half of the objective for each respective element of the subject by dividing the light with a half-aperture stops at the aperture of the condenser or in the planes of the Ramsden discs. Various kinds of stops have been used, and, while they reduce the resolving power by one half, this loss may be of little significance in practice, unless one is working [illegible] lution.

For stereo photomicrography with [illegible] the most convenient way to secure right and left eye views from a single objective is to divide the light by the use of polarization, as devised by Schulman (U.S. Patent No. 1,528,931) in the form of the Stereo Polarizer (Fig. 9) available from the Bausch and Lomb Optical Company. One-half of the polarizer polarizes in the direction of its handle, while the other half in the [illegible] at right angles to the handle. When placed under the iris of the substage condenser, with the handle pointing directly away from

Figure 7. Shelf support for stereo camera (see Fig. 6). The camera lenses fit between the tines of the fork in proper alignment which provides easy removal and replacement.

the observer, the emission pupil of the eyepiece is composed of "right" and "left" half-field. Two cap analyzers are placed over the two oculars: the right with its white line oriented vertically, the left with its white line oriented horizontally. A monobjective binocular microscope thus equipped is focused and manipulated in the normal manner, but it will yield to the observer a stereoscopic view of the subject at all magnification. The light from the right half of the objective will reach only the right eye, while that from the left half will reach only the left eye. This arrangement produces a stereoscopic presentation of the subject. The diagram (Figure 10) shows the path of light as it is affected by the stereo polarizer.

Camera such as the *Realist* can be used also with this type of microscope for stereo photomicrography, when higher magnification of the subject and better resolving power are desired. When the ocular tubes of this type of microscope are parallel, all that is necessary is to adjust the distance between them so that they center within the camera lenses, which are set to infinity. When the tubes converge, or do not remain parallel as their interocular distance is changed, then prisms of proper power in mounts of the same type as used with the biobjective Greenough microscope will be required. The power of the prism is obtained by dividing the tangent of the angle of inclination from the vertical by 0.01. (See Table I) The camera should be supported (Fig. 11) in a similar manner as described before, or it can be hand held. The illumination of the microscope is described in standard texts on microscopy and the Köhler method will generally give the most uniformly satisfactory results for this type of work.

Photography

When the microscope is focused properly for the normal eye, it will usually be in focus on the film of the camera having its lens set to infinity. If the observer uses spectacles for distance, he should use the same spectacles when focusing the microscope. Occasionally, the difference between the focus of the observer and the true infinity focus is too great to yield sharp images in the film plane, especially at high magnifications of the monobjective microscope. The

best way to avoid this difficulty is to focus any small telescope or a small field glass upon a distant object (several blocks away), then place the telescope over each ocular of the microscope and focus the microscope while looking through the telescope or field glass. This will insure correct infinity focus. Most modern binocular microscopes provide an adjustment for one or the other eye piece to take care of individual differences in the eyes of the observer. These should be set to give the same focus in both eyepieces. The best way is to focus the microscope (using the telescope or field glass when necessary) with the non adjustable eyepiece. Then the telescope is applied to the adjustable piece, which is rotated until the focus appears as sharp as it did in the other eyepiece.

The problem of evenness of lighting of the two views is ordinarily not encountered in the binocular monobjective microscope. But, if through accidental or inherent misalignment of the beam-splitting prism the light is not equally divided, a difference may be apparent in the pair of views on film, which is more sensitive to minute differences in luminance than are the human eyes. When such uneven illumination becomes apparent, the alignment and proper centering of the substage polarizer should be checked, and, if that be found in order, the instrument should be examined by a competent person.

With the Greenough microscope, it is necessary for the operator to adjust the light carefully for even distribution of light to each eyepiece. The best way to insure even and uniform illumination reaching each eye is to measure the light emerging from each eyepiece individually with a sensitive light meter, such as is described in the next section. If such an instrument is not available, one can

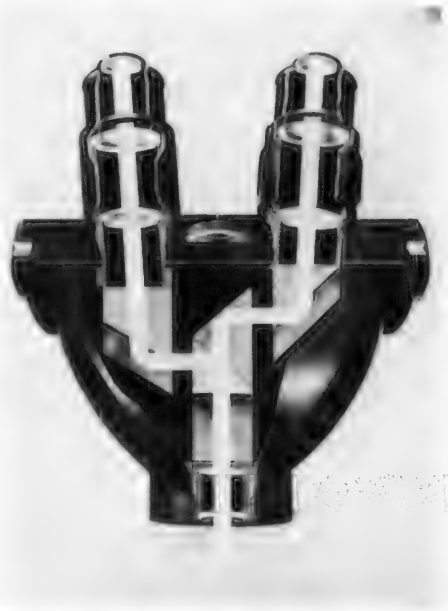


Figure 8. Light path within the binocular body of an AO-Spencer Microscope. The beam of light from the objective is divided into two equal identical beams for each eyepiece.

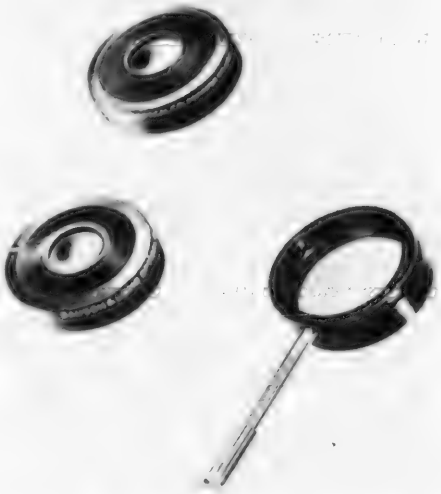


Figure 9. Shulman's polarizing equipment for adapting a monobjective microscope for stereo observation and photography. Courtesy of the Bausch & Lomb Optical Co.)

look quickly with the same eye through both eyepieces. This may give a relative idea of the comparative brightness, but only very approximate results may be expected. It cannot be recommended for the making of color stereo photomicrographs, where a mismatch of light intensity will show. It should be remembered also that color photography requires proper color temperature of the light source. Correct reproduction of the color of the subject and its background depends upon the color temperature of the light source corresponding to the color sensitivity of the film used. For instance, when *Kodachrome Type A* film is used, the color temperature of the light source should be 3400K at the film. A light source of 3200K will produce slight reddening of the entire field, unless a suitable light-balancing filter is employed in front of the light. If the light intensity is too great, only neutral density filters should be employed to reduce it. Rheostats or transformers are not suitable for the control of light in color photography, since a varying voltage will change color temperature. A difference of 10 volts in a 110 volt line may produce a difference in color temperature of 100K, which will be objectionable in a color picture.

For black-and-white photography, most photographic emulsions will be found suitable for stereo photomicrography on 35mm film, though the medium-speed panchromatic films offer the best combination of contrast and fine grain so desirable for making enlargements. The negatives can be printed by contact in full lengths onto positive film, which can be cut apart into individual pairs and mounted for viewing or for projection. Also, such negatives can be enlarged as prints on paper, mounted on cardboard mounts similar to the classical stereoscope pictures so popular during the earlier part of this century, for viewing through a parlor-type stereoscope or through the simple one-piece plastic stereo viewer recently developed by Morgan & Lester and included in their *Stereo Realist Manual*.

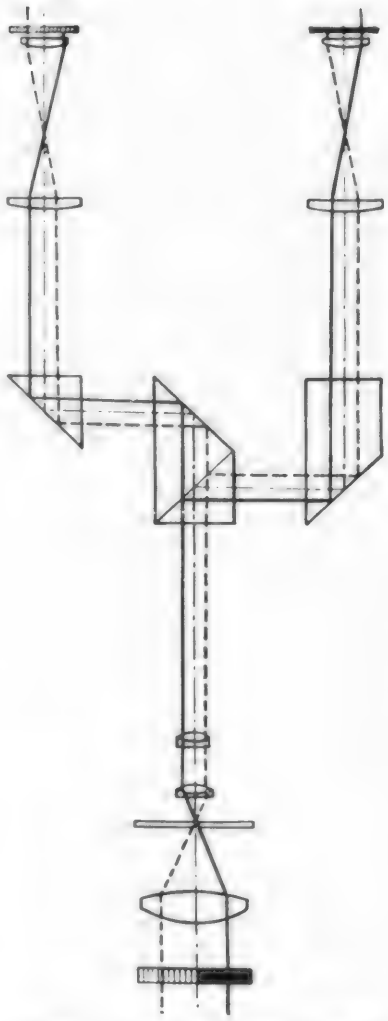


Figure 10. Light path through binocular biobjective microscope equipped with the polarizing equipment of Fig. 11. Light from the right half of the objective is seen with the right eye, that from the left half is seen by the left eye.

It is best not to use for stereo photomicrography films supplied as "20 Stereo Pairs" (*K335 A*), the purchase price of which includes processing of the film and mounting the stereo pairs in cardboard mounts. Since stereo photomicrographs may not always produce rectangular outlines of the individual frames on film, the individual transparencies may require judicious cutting apart by the microscopist. This is often quite beyond the scope of standardized procedure employed for a regular mass production mounting service. It is recommended that the regular cartridges of film be employed for this work, such as the *K135* or *K135A* stock, or exposure rolls of *Kodachrome* film or *Ansco Color* film, and that these be returned to the microscopist in uncut lengths.

Whether the stereo photomicrographs are made in color or in black and white, the maker is cautioned not to overlook the importance of positively identifying the "right" and the "left" view of each pair. Though most stereo cameras employing 35mm film have identifying notches which are reproduced on the exposed film, these may not be visible on film containing photomicrographs. Any identification applied to all the "right" or to all the "left" eye images upon the entire length of film prior to cutting it apart into individual frames will be invaluable for proper assembly of the pairs into mounts for viewing or for projection: the "right" image, as it appeared through the right ocular, must be seen by the right eye. The same applies to the "left" image: it must be seen by the left eye, as it appeared through the left ocular. Failure to observe this requirement will result in great confusion and may lead to viewing the pairs as pseudo-stereos, where cavities appear as mounds and vice versa.

Figure 11. Stereo Realist camera supported on the inclined ocular tubes (parallel, not convergent) of a Leitz binocular monobjective microscope mounted on the Panphot. The lens hoods provide light traps. An ultra-sensitive light meter shows in the background.

The perception of depth secured in stereo photomicrographs depends upon the angle of inclination of the objectives and their inherent depth of field. It must be realized that the camera lens has no power of adjustment or accommodation such as the focusing of the eye. Neither does it have the imagination which frequently enables us to interpret depth in a flat picture. Thus, the eye will see a little more depth through the stereo microscope than the camera will reproduce on the thin photographic emulsion. Also, the eye will adjust itself as it beholds the center or the edge of the field for with the total field of

it may not be possible to get the entire field in sharp focus for the camera lenses due to the curvature of the field inherent in these oculars. However, these are problems common in photomicrography, and for further guidance the reader should consult standard references dealing with these problems.

The Problem of Exposure

Exposure for stereo photomicrographs is critical. It is more so when color film is used, but it is not unimportant in black-and-white photography. The need for uniform brightness of both images is an indispensable prerequisite. Visual evalution is at best not reliable. Ordinary exposure meters are not sensitive enough for critical work, but will be found helpful in the absence of other means and definitely better than the judgment rendered by the eye. However, if a great deal of stereo photomicrography is done consistently, one gradually acquires the ability to estimate exposures correctly, just as one does in other applications of photography.

The usual trial and error methods can be applied and when the light source employed is strong enough, a fair idea of the exposure can be obtained by holding an exposure meter (*General Electric, Hiekok* or other foot-candle measuring instrument) in such a manner that the entire light output emerging from one of the eyepieces reaches the meter cell. With the calculator of the meter set to the speed rating of the film employed, the exposure found opposite the f/ aperture mark will be quite close to being right.

A satisfactory method for measurement of small amounts of light, capable of disclosing minute differences between the brightness of the two images which may call for the adjustment of the illumi-

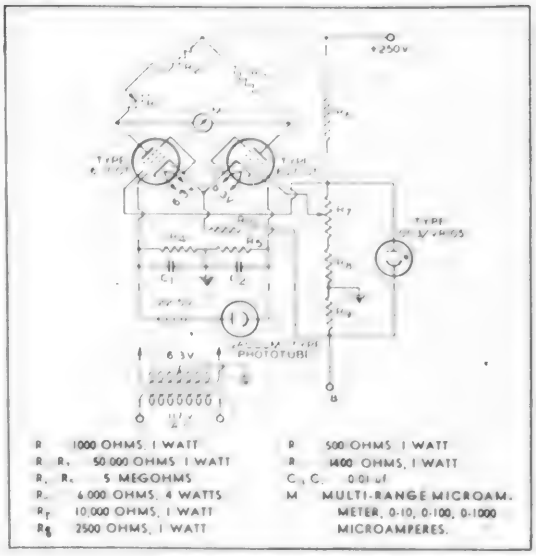

+250v
6.3v
PHOTOTUBE
R 1000 OHMS, 1 WATT
R1 R2 50,000 OHMS, 1 WATT
R3 R4 5 MEGOHMS
R5 6,000 OHMS, 4 WATTS
R7 10,000 OHMS, 1 WATT
R8 2500 OHMS, 1 WATT
R 500 OHMS, 1 WATT
R 1400 OHMS, 1 WATT
C1 C2 0.01 µf
M MULTI-RANGE MICROAM-METER, 0-10, 0-100, 0-1000 MICROAMPERES.

Figure 12. Circuit for measurement of small values of illumination used for estimating exposure and balancing picture pairs for stereo photomicrography. (By permission of RCA, copyright proprietor).

nation or some of the light transmitting media, and equally satisfactory for measurement of light in terms of correct exposure, is the light meter used successfully by Lester during the past five years for all kinds and types of photomicrography. It has been found consistently dependable for photomicrography in color or in black-an white within the range of the optical microscope. The light meter is based upon a circuit suggested by *RCA* for electronic measurement of very small values of illumination (Figure 12). Capable of measuring illumination corresponding to the phototube current of only 10^{-10} amperes, the instrument, when operated with a vacuum-type phototube, such as the #929, has a luminous sensitivity of 45 microamperes per lumen of light flux. This type of phototube, having a spectral sensitivity designated as S-4, has been found most suitable for

photomicrography in general and stereo photomicrography in particular.

The phototube is contained in a small metal housing, forming at the end of a shielded two-conductor microphone-type cable a convenient probe with a "window" well suited to the needs of photography on 35mm film. The opening of the probe has an area of about 0.75 square inch, effectively exposing the light-sensitive area of the phototube, which is about 0.6 square inch. Since the maximum area of the image formed upon the film seldom exceeds 0.7 square inch, the probe covers the image of a single frame area fully when centered upon the ground glass, without any exploratory movements (Fig. 13).

The phototube current is measured by a sensitive multi-range microammeter (1 to [illegible] microamperes d-c in 3 ranges) which, when suitably calibrated over a wide range of exposures of a variety of subjects and magnifications, gives reliable indications for consistently correct exposures. Also, its indications are most helpful for balancing the light reaching each of the two picture areas. Its linear characteristics make calculations simple. The instrument was used to establish the fairly consistent relationship between rated film speed and the required exposures: with the probe centered over a ground glass covering the film gates, *Kodachrome Type A* film is correctly exposed as follows:

[illegible] microamperes . . . . [illegible] second
100 microamperes . . . . 0.25 second
[illegible] microamperes . . . . 0.05 second

While the above relationship between phototube current and exposure was established empirically, it was found through calculations that image brightness corresponding to [illegible] foot-candles of illumination falling upon the ground glass will produce a phototube current of about .25 microamperes, requiring an exposure of 1 second for a satisfactory reproduction of the object upon *Kodachrome Type A* film.

The circuit of this instrument is a d-c amplifier, which is stabilized by the incorporation of a balanced bridge circuit, with a resistor in one arm of the bridge corresponding to the phototube in the other arm. Since both arms of the bridge use identical tubes (within limits of commercial tolerances), and drift due to change of temperature or voltage is multiplied, since it occurs in the same direction in both arms of the bridge. Some drift, of course, remains, being particularly noticeable during the warm-up period. After about 15 minutes, the instrument becomes reasonably stable, and only a slight adjustment of one of the two balance controls is needed to maintain the zero setting. Calibration stability is good: as long as the zero setting is properly adjusted, the instrument will consistently duplicate its indications. The slight inconvenience of the small residual zero drift is more than offset by the low cost of the instrument—less than $75.00, of which more than one-third is the price of a good multi-range microammeter. Upkeep is low, the instrument operating from the 115-volt a-c line through a small [illegible] transformer with trifling current consumption, while [illegible] current is supplied by a [illegible]-volt hearing-aid battery which usually lasts a year or more.

It will be found more convenient to employ in this work two cameras of the same make and model: one loaded with film, the other with its back removed and a piece of fine ground glass taped in its film gate. Such arrangement will be found most helpful for light measurement and for occasional checking of the sharpness of the image and of the gen-

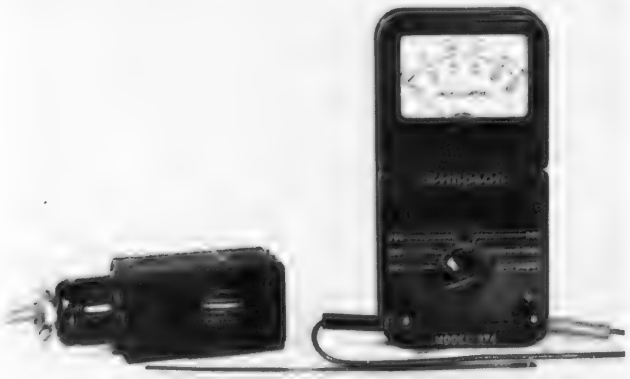


Figure 13. Probe of the light meter showing the phototube and a 5-range d-c microammeter.

ural composition of the subject within the [illegible]

Summary

Stereo photomicrography in color and in black-and-white with cameras of fixed interocular distance requires a suitable prism between each eyepiece of the binobjective microscope and the camera lenses to bring the two optical axes into coincidence. Monobjective binocular microscopes require a simple system of polarizers to divide their single image into [illegible] The monobjective binocular microscope [illegible] micrographs of high magnification and good resolving power. Equipment and methods are described for securing stereo photomicrographs of good quality with the aid of either type of microscope. Principles of lighting are suggested and a practical method for determining correct exposure is offered.

Bibliography

Allen, R. M. 1911. Photomicrography. D. Van Nostrand Co., New York.

Jackson, Alan (n.d.) Amateur photomicrography with simple apparatus. Focal Press—Pitman, New York.

Lester, H. M. [illegible] Morgan & Lester, New York.

Linssen, E. F. 1952. Stereo photography in practice. Fountain Press, London.

Maurer, John A. 1933. Exposure control in photography. J. Biol. Photogr. Assoc. 1:2:175-185.

Photography through the microscope. 1952. Eastman Kodak Co., Rochester, N.Y.

Photomicrography. 1944. 17th ed. Eastman Kodak Co., Rochester, N.Y.

Richards, O. W. 1951. Tridimensional cytoh[illegible]

Shillaber, C. P. 1944. Photomicrography in [illegible] practice. John Wiley & Sons, New York.

RCA Phototubes, Form PT-20R1, Radio Corporation of America, Harrison, N.J.

A Simple, Inexpensive Surgical Camera*

LESLIE E. HIER AND JAMES A. DIMOND

The University of Chicago, Chicago, Illinois

THERE have been many articles written on the subject of surgical cameras, but only a few have dealt with the type of equipment that anyone with only average time and facilities can build. We realize that there are many photographic laboratories that cannot afford the high price and intricate mechanisms of the stands that are now on the market, or the cameras with different types of lenses that are necessary to do better than amateur work in surgical photography.

The camera and attachments that are to be discussed are not so new that this same idea might not have been thought of before; but we hope that our application might be useful to someone else in our field.

Every laboratory has to be geared to a combination of many needs. To a free lance medical photographer, whose job is to travel around the city taking pictures in many different hospitals, there are many instances when he just does not have time to load up the car with numerous lights, tripods, and camera equipment. When the photographer enters the operating room on short notice, the operation is usually in progress and everyone is eagerly waiting for him. We realize that these situations do not arise very often, as the doctor or head nurse usually try to give us advance notice when photography will be requested. In any case, valuable time would be used in setting up camera and stand, attaching the light source, acquiring a stool or ladder to stand on, focusing, and making the exposure. This may not seem like much to the photographer, but to the doctors and nurses, who are waiting, the time seems like [illegible]. Regardless of the quality of your pictures, the doctor will consider your efficiency in the operating room before he calls you again. This all leads up to the problem which we solved in our department.

We found it necessary to devise a way to make surgical photographs in color or black and white that was fast, inexpensive, and due to a limited budget, required equipment that we already had or could build ourselves at minimum expense.

A number of our needs brought forth the requirements of such a camera and suggested the specifications we were to fulfill. (Fig. 1). The camera must be light and simple enough for one man to operate, with perhaps an unskilled assistant that could be obtained from the operating room staff. It must produce pictures suitable for either standard 3¼ in. x 4 in. [illegible] slides. It must not take more than a few seconds to set the exposure, focus the picture and must not come in contact, in any way, with the [illegible]. These requirements suggested a camera with a 2¼ in. x 2¼ in. [illegible] which could subsequently be [illegible] to 2 in. x 2 in. size. Our idea was to have it at a preadjusted focus, but to have it easily variable to one of several working distances. The [illegible] camera must be self contained and [illegible] enough to enable it to photograph an operation in a body cavity.

We began with the construction of a support (Fig. 2) which consists of a plywood board 30 in. x 8 in. x ¾ in. thick tapered into a handle at one end. An opening 3¼ in. x 4 in. was cut in the center of the board to permit the use of our camera. A circular opening with a diameter of 5 inches was made, as close to the lens as possible, to accommodate the flash reflector. Two rectangular openings 1½ in. x 7 in. were made 10 inches from the center of the camera lens to hold the pen flashlights. Our pilot model incorporated [illegible] camera with synchronized flash (Fig. 3). We used [illegible] but found in our experience we found SM lamps have a greater tendency to explode than other types, and thus have changed over to No. 5 lamps, with an equal amount of success. Our flash duration with the No. 5 (13 milliseconds) is considerably slower than the SM (7 milliseconds) but still great enough to stop all normal body movement and give correct color balance plus or minus supplementing CC filters, for *Type B Ektachrome* roll film. We would be [illegible] ourselves. We found the light intense enough to allow us to stop down for great depth of

* Presented at the 24th Annual Meeting, Atlantic City, 1954, by L. E. Hier.
Received for publication August 27, 1954

Figure 1. Camera mount showing top and bottom sides completely equipped

Figure 2. Detail view stripped, showing (M) camera mounting bracket; (L) flash bracket; (O) cloth protective cover; (G) metal calibrated plate for focusing; (F) movable spring arm; (E) pressure collar for holding pen lights; (C) plywood board.

Figure 3. Detail view. Same as figure 2 only fully equipped

field at the distances at which we were work- [illegible] We use standard +1, +2 and +3 *Portra* lens attachments which can be used separately or in combinations to give [illegible] different fields of view and different working distances. (Table I). Our focusing [illegible] is accomplished by two pen sized flashlights mounted at either side of the camera and adjustable to four positions corresponding to the working distances calculated for our +1 through +4 *Portra* lens combinations. (Fig. 4). Our penlights are held in place by means of a tubular clamp with two round plugs extending from each side. These are slipped into circular openings on two right angle brackets fastened to the board. This permits a swivel action needed to assume the four variable distances. On one side of the clamp, there is fastened a spring arm with an extended right angle plug at the tip. This plug fits into pre-calibrated holes drilled into a 2mm metal plate, also fastened at a right angle to the board.

TABLE I

Table of Portra Lenses and Corresponding Field Size

Portra Lenses	*Field Size*
Plus 1	11 in. sq.
Plus 2	7½ in. sq.
Plus 3	5½ in. sq.
Plus 4	4½ in. sq.

The calibration of the penlights is accomplished after the apparatus is assembled, by focusing on ground glass of the camera or by careful measuring of the working distance. They are mounted and calibrated in such a manner that the center of the focusing spot lies directly in the center of the camera field.

Figure 4. Detail view of focusing mechanism; (G) 2mm thin metal plate; (H) calibrated holes for +1, +2, +3, +4 *Portra* lenses; (F) movable spring arm; (E) pressure collar for holding pen light

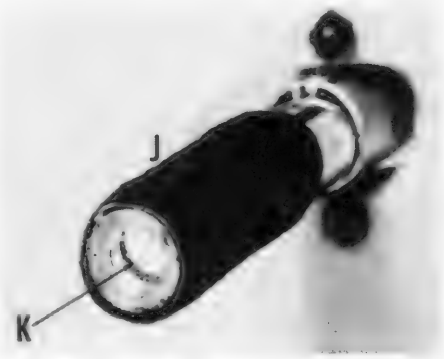


Figure 5. Closeup of auxiliary focusing tube; (J) metal slip tube over end of pen light; (K) small 11.5mm F.L. meniscus lens in mounting.

Both lights are equipped with an auxilliary tube which slides over the end of the flashlight with a moderate friction fit. (Fig. 5) There are [illegible] lenses 11 mm F.L. mounted in one end of these tubes and they are adjusted so that the images of the filament might be clearly seen. Both lamps are then rotated so that the filament can form a cross at the precise center of the lens when superimposed. Subsequently, when the camera is the correct distance from the field, these two filaments together with the pivoting action of the pen flashlights will form the cross image. During the exposure we have found it advantageous to momentarily turn off the operating room lights as they tend to overpower the small pen flashlights. Depending on the operating room light, there may also be some effect on the color balance.

The flash is mounted next to the camera [illegible] of a small [illegible] x [illegible] in wooden block with an ordinary spring clip [illegible] handle holder, screwed to the top and acting as a clamp for the flash gun. (Fig. 2). The [illegible] [illegible] [illegible]

Figure 6. Camera mount being used in surgery. One man operation but adaptable for two if needed.

to enable the flash, when in position, to project a beam of light able to illuminate most surgical cavities up to the field which is covered by the 4 × 4 supplement. The flash is baffled by a translucent or matte *Lucite* shield which diffuses the light for more even illumination. (Fig. 1). The back of the flash is protected by a cloth cover with a dividing [illegible] for changing lamps. These two measures protects the surgical field in the event of an exploding flash bulb. A small drape can be made which can be sterilized and fitted over the bottom of the camera mount to offer further protection from contamination of the surgical field.

The dimensions for this unit are not too critical and can be made to fit available equipment. We have found the actual operating time for taking a picture with camera to be [illegible] pictures, however, you must change lamps and advance the film so that a little more time is required. This camera can be operated at [illegible] kept on the center of the desired field. With experience we found that we could judge visually from the size of the operating field [illegible]

Since we have constructed this basic mount we have found that it can be used with [illegible] *Leica* with particular success.

Except for the labor involved in the construction and calibration and the approximate $60.00 for the *Argoflex*, the whole unit cost less than $5.00. This includes the plywood for the mount, the pen flashlights, and the [illegible]

A Useful, Low Cost Densitometer*

ARTHUR W. PROETZ
St. Louis, Missouri

TO the professional color photographer the best densitometer obtainable is essential equipment. To the amateur and the occasional colorist it is a desirable but expensive luxury. For work requiring anything less than the utmost accuracy in densitometers the reasonable facsimile to be described will serve remarkably well and, provided one has a small projector and a light meter, will cost nothing.

It consists of a brass tube with a small hole at one end and a photoelectric meter at the other. This basic equipment will require calibration, which turns out to be less of a problem than might be anticipated, provided the following measurements are strictly adhered to.

The first requirement is a short piece of brass tubing, 4½ inches long, with an outside diameter of 1 1/16 inches and an inside diameter of 13/16 inches. This is stock material and can be had for a few cents at any brass supply house.

One end is closed by soldering into it, opening a thin metal disc having a circular hole ¼ inch in diameter at its center. The other end is fitted into the photoelectric cell aperture of a *Norwood Director* light meter. If the tube is of the diameter stated the fit

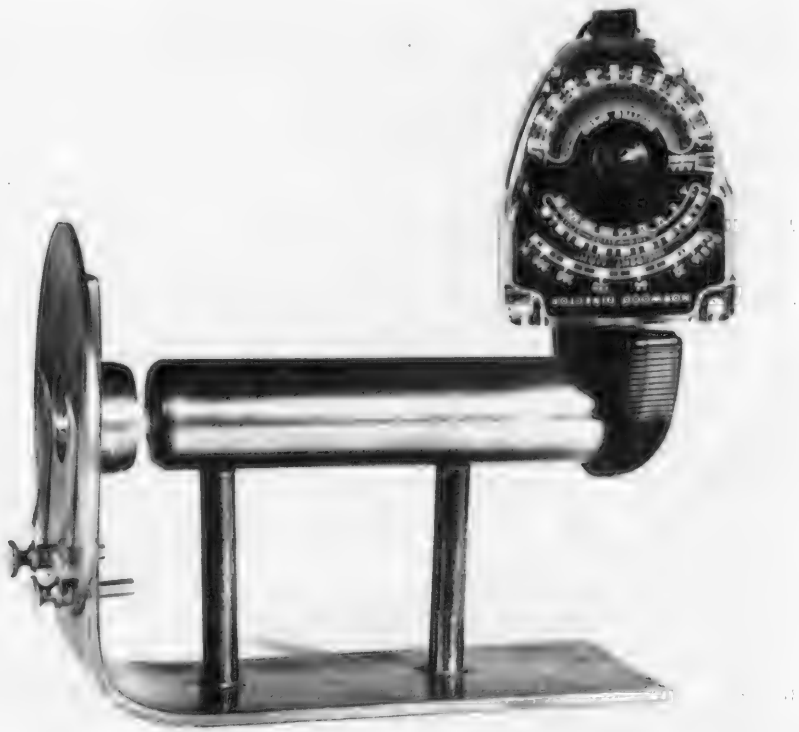


Figure 1. Brass tube, with light-meter attached, on a convenient support. The disc at left with clips for holding filters is not an essential part of the instrument.

* Received for publication July 21, 1954.

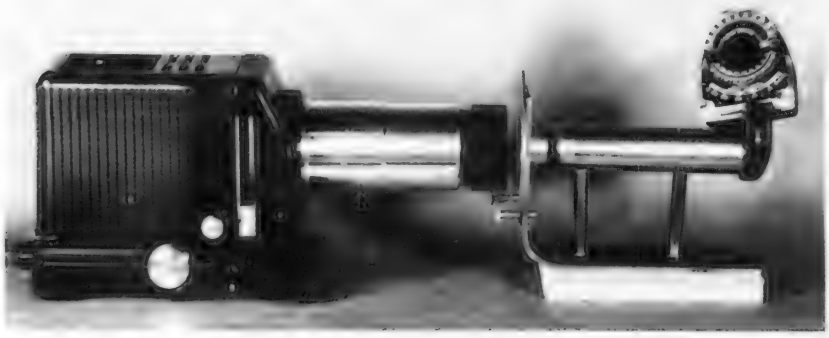


Figure 2. Tube and meter in position before the projector. The film to be measured is placed against the small hole in the slit between the tube and the filter holder.

will be sufficiently snug to hold the meter firmly in place.

This constitutes the instrument. It may be held in the hand or clamped to a convenient laboratory support, or better still a simple permanent support of the proper height may be made for it, as shown in the picture. The metal sheet has a rectangular plate, with two microscope stage clips to hold the filter or a sheet of heat-resisting glass, a refinement but not essential.

When the apparatus is set, carefully aligned before an ordinary 35mm slide projector using a 100-watt bulb, the meter should read about 1.14. This will vary slightly with the optical characteristics of the projector but if the length of the tube and the diameter of the hole are as specified the reading will not be much different. Line voltage variations do not affect any other electrical instrument. A check should be made each time before a film is applied for measurement.

Calibration can then be made using the maximum reading as a start. Proportionality of illumination is what is required, and under a given set of conditions which should not [illegible] the readings will prove sufficiently accurate for most purposes. The instrument [illegible] for color separation negatives and matrices. The film is applied to the [illegible]

Readings for this set-up are as follow:

Norwood Director Reading	Density (readings on Weston Analyzer)
800	.08
650	.12
[illegible]	.16
[illegible]	.2
[illegible]	.25
250	.36
[illegible]	.4
160	.56
[illegible]	[illegible]
[illegible]	.76
[illegible]	.63
63	[illegible]
[illegible]	[illegible]
40	.86
[illegible]	[illegible]
[illegible]	1.00
[illegible]	1.08
16	1.14
13	1.[illegible]
10	1.[illegible]
[illegible]	1.[illegible]
6	1.38
[illegible]	1.45
4	1.[illegible]
3	1.68
[illegible]	1.[illegible]
1	[illegible]

If the readings are compared with [illegible] pared with standard densitometers they will however be consistently off and the [illegible] of illumination which is what counts, will be accurate. Accuracy in the very lowest range will depend somewhat upon the ability of the observer to extrapolate a function which the high cost of top[illegible] instruments will [illegible]

Some Notes on Underwater Color Photography *

WILSON A. SWANKER

THE interest in color photography of underwater biological material is rapidly increasing among both professional and amateur photographers. There are several movies being shown which employ underwater color as a small part to a major portion of the sequences.

The use of black-and-white film of any type requires little discussion. The emulsion speed is sufficiently fast to permit its use with wide variety of lighting conditions. However, when color film is used several factors demand consideration. Of the three types of *Kodachrome*, *Commercial Kodachrome* is the least suitable for several reasons. It is a *Type B* emulsion which requires a Wratten No. 85 filter when it is used in daylight. As it is very blue sensitive, the water effect on its use is very evident. *Commercial Kodachrome* is slower, has lower contrast and is slightly grainier than regular *Kodachrome*. The *Daylight Kodachrome* film is very satisfactory, unaided, to as deep as 8 feet, and down to 30 feet with filters. Below 30 feet *Type A Kodachrome* should be employed.

When using it during shots at depths of 6 or 8 feet, there is little need for a filter if the angle of the sun is high. An intense blue sky will naturally increase the blue color content and may require the use of a filter such as a Wratten *No. 86*. For depths down to 15 feet with a good high angle sun, a Wratten *No. 86* filter is necessary. If the angle of the sun is poor, a Wratten No. 85 filter must be used. For depths of 15 to 30 feet it is necessary to use a *Wratten No. 85* filter. Greater depths require the use of *Type A Kodachrome*.

At depths of over 25 to 30 feet the greens and blues are so predominant due to the absorption of the red that the light is essentially monochromatic. A selective process seems to make up for this loss in the green portion of the spectrum when one is viewing colored objects at these depths but he cannot make these compensations when viewing a film. Therefore, color pictures taken at depths of over 25 to 30 feet require artificial lighting which can be accomplished with a waterproof spot light. A standard automobile headlight of the sealed beam type can be run from a storage battery also very satisfactorily.

Underwater filming, like air filming, depends upon the degree of visibility. Naturally one has a greater [illegible] with faster black-and-white films than with slower color film. The density of the water medium varies with depth, temperature and the amount of suspended material in the water. The type of bottom and the proximity to shore are two important factors that influence the amount of this suspended material. There is less of this matter away from shore beyond the tidal wash. Southern waters are freer of this material than all the northern waters. Salt water is more dense than fresh water. The lower the water temperature the denser the water. All of these factors actually affect the visibility. It is well to remember if the visibility is less than 10 feet, all pictures will be poor. Clarity of water is the visibility, it is then all, good (little perceptible difference in objects seen at a distance under water and on the surface above) in shallow water with bright overhead sun use one to two stops wider opening for the underwater shot than the atmospheric one. A variable factor for computing the stop setting has been suggested, i.e., 1.5 to 2 for ideal lighting to 12 to 16 for poorer conditions. The variability is so great that a better index would be serial exposures with varied factors to establish one's own table. A good light meter is still the best index. Any light meter can be incased in a waterproof bag or box for use under water. Such equipment is available commercially or one can build a water tight *Lucite* box for his light meter. Don't be surprised at readings different from those in [illegible] you are accustomed to. The [illegible] of the *Lucite* [illegible] will be a similar cover over the camera lens. The [illegible] can be corrected for this filter effect by [illegible] a fixed light source or regular exposure with the meter in and out of the box. The [illegible] It must be borne in mind that the camera box window also has a filter factor to be considered. This is particularly true if the camera box window and the meter box window are of different materials.

* Received for publication Nov. 23, 1954.

A very important problem in underwater photography is the water proofing of the equipment. There are several waterproof housings for camera equipment on sale commercially. Unfortunately, they are quite expensive. If deep water work is to be done, [illegible] is essential. If the depth of operation is no [illegible] water tight type of homemade equipment will prove satisfactory. The simplest is a rubber or plastic bag. If rubber is used, [illegible] cemented into one end for the lens. If a reflex camera is used, two windows will be necessary. A clear plastic is preferable as no windows are needed. One must remember to have the same plastic over the light meter or to use a correction factor. With a pliable type of plastic bag like this, most of the adjustments can be made through the bag. The bag must be somewhat larger than the equipment as pressure will decrease its size.

A waterproof box can be made of sheet *Lucite* cemented together with one side of pliable plastic or a side bolted on with a [illegible]. It is necessary to use [illegible] adjustment mechanisms or be satisfied with a single shot fixed focus effort, if *Lucite* is used on all sides. If one side of the box is of pliable plastic, rough adjustments can be made and the pressure problems are automatically solved by equalization.

A very good movie camera for underwater work is the electrically operated *B & H* [illegible] 16mm camera obtainable in army surplus type. The only control needed is a switch attached to the outside of the case.

A [illegible] for underwater photography is a tripod or monopod. Although the photographer may not notice it, there is usually a to and fro current present. A movie made in this may make the audience seasick when it is projected. The monopod is more simple to operate than the tripod. It may be advisable to weight it with lead as things are quite bouyant under water. This, of course, depends on the size and weight of the camera housing. Naturally, a monopod or tripod cannot be used with the bag type of housing unless a coupling is cemented into the wall of the bag. The more openings one makes in the bag the more opportunity there is for a disastrous leak.

A Simple Method of Calculating Exposure for Closeup Photography*

MARGERY P. MANN

Division of Plant Pathology,
University of California, Davis, Calif.

EVERY [illegible] the long lens-to-film distances necessitated by photographing objects closer than 8 times the focal length of the lens has run into the problem of increased exposure. The relative aperture engraved on the lens mount is then no longer the true relative aperture, and the exposure must be increased as the distance between the lens and film is increased.

The formula: Effective f-value

$$= \text{Indicated f-value} \times \frac{\text{Lens-to-film distance}}{\text{Focal length}}$$

* Received for publication Nov. 20, 1954.

[illegible] is used. The indicated f-value is the setting engraved on the lens mount which the photographer selects. The lens-to-film distance is determined by placing a ruler or [illegible] the same plane as the film and measuring the distance between the center of the lens and the film plane. The focal length is engraved on the mount of most present day lenses. With this formula, when the indicated f-value is 32 or 45, which one might wish to use to get maximum field depth, the effective f-value would be 31.99 or some other figure requiring further calculation for the correct exposure.

A shorthand method of calculating this increase has been worked out using this formula and an exposure meter. The meter reading is taken in the usual way. Going back to the formula, the lens-to-film distance is measured and recorded, as is the focal length of the lens. As to the indicated f-value, one *pretends* he wishes to take the picture at that f-stop which is equal to the focal length of the lens being used — with a 10-inch lens, the picture is assumed to be

taken at f/11 with a 4-inch lens at f/4, and so on. Therefore, in the formula, the indicated f-value and the focal lengh cancel out, and the effective f-value becomes equal to the lens-to-film distance.

For an example, a 10-inch lens at f/10 with a lens-to-film distance of 16 inches allows only as much light to reach the film as would reach the film if the lens were focused at infinity and the lens stopped down to f/16. Note on the meter the exposure indicated for f/16, and move the dial with the f-stop engraved on it until f/10 is opposite the exposure which had been indicated for f/16. Moving the dial to accommodate this change in exposure increases the exposure indicated for every f-stop shown on the meter in the same ratio as the difference between f/10 and f/16. If the picture is to be taken at f/32, one reads the corrected exposure opposite f/32. With a little practice, one automatically moves the f-stop equalling the focal length to the exposure opposite the f-stop equalling the lens-to-film distance.

MEDICAL AND BIOLOGICAL ILLUSTRATION

CONTENTS

January, 1955

A Macrophotographic Apparatus for Use with Electronic Flash in the Field . . . . . Ernest Schälow

The Presentation of Medical Evidence . . . . . Peter G. Cull

The Bourges Process . . Robert Ollerenshaw and Peter G. Cull

Multiple Flash Photography . . R. H. J. Brown and J. A. Popple

Differential Staining and Mounting of Human Brain Slices . . . . . D. H. Tompsett

Counting of Chylomicrons . . . . . K. J. Kingsbury

Equipment and Methods:

Exposure Increases for Close Up Work
Continuous Disposable Background
Standardized Photomicrographic Technique for Colour Transparencies
Lightweight Transparency Mounts
Ilford Universal Miniature Slide Cabinet
Gelatin Matrices: Two Processes of Value to the Illustrator
Meopta 16mm Film Editor

Abstracts, Book Reviews, Motion Pictures and Reports from Societies

Annual Subscription $7.00

Published by the
BRITISH MEDICAL ASSOCIATION
TAVISTOCK SQUARE, LONDON, ENGLAND

SEND ORDERS TO GRUNE & STRATTON, INC., 381 FOURTH AVENUE, NEW YORK, N.Y.

BOOK REVIEWS

DIRECTORY OF PROFESSIONAL MOTION PICTURE FILMS AND AUTHORS, *First Edition, Professional Publications, 2010 Kentucky St., Lawrence, Kan., 326 pages (1954), 5¾ in. x 8¾ in., cloth bound, price $7.50.*

According to Mr. C. D. Young, Director of Professional Publications, this represents the only comprehensive, classified, modern reference book on professional motion picture [illegible]. For its compilation, thousands of questionnaires and letters were sent to individuals, film libraries, film producers, visual education departments, universities, hospitals, and other film users. From the large amount of data obtained, the information was arranged in logical organized form for producing the book. Medical films are listed under 28 separate chapter categories, beginning with atomony [illegible] science to venereology. Each film is listed by its title, followed by its author or authors, plus the year of its production and other essential details pertaining to its availability. Dental films are given under 11 separate chapter categories. Background data on authors are given in a separate section. There is no doubt but that this directory will prove to be a useful tool to those who have reason to consult it. It is the intention of the publishers to keep the volume up to date by [illegible] and we can only wish them our whole-hearted support in this worthy project.

HISTOPATHOLOGICAL TECHNIC — Including a Discussion of Botanical Microtechnic, Aram A. Kruyan and R. B. H. Gradwohl, Second Edition, C. V. Mosby Company, St. Louis, Mo., 862 pages, illustrated, 5½ in. x. 8½ in. (1952), cloth bound, $6.75.

The photographer who also does laboratory [illegible] will find this book a useful source of condensed information. It represents the author's choice of practical methods from the large number described in reference works. In this edition the frozen section method, paraffin embedding methods using the *Autotechnicon*, and sharpening microtome knives are emphasized. To the latter this reviewer must take exception in that he believes stropping should not be done to microtome knives. The book gains from the chapter on methods for plant preparations, as even in medical laboratories it is sometimes necessary to prepare slides of botanical material. Colored photographs give some indication of how such preparations should appear when well stained. Methods for exfoliative cell diagnosis are included. The chapter on museum mounts remains old-fashioned as no mention is made of the modern methacrylate mounts that are now replacing the old wet mounts. The German word "xol" is used rather than the English translation of it, *xylene*, favored by the American Chemical Society and others. (O.W.R.)

THE PRACTICAL WAY TO PERFECT ENLARGEMENTS, *Joseph Foldes, Camera Craft Publishing Co., 95 Minna St., San Francisco 5, Calif., 190 pages (1954), illustrated, 6¾ in. x 9¾ in., cloth bound, $5.00.*

This is one of the best, if not the best, book on enlarging which has ever been published. It is very sensibly organized in 24 [illegible] chapters. The author recognizes that the first thing to consider in the production of a suitable negative. Therefore this constitutes the first chapter of his treatment. Following this, he describes the necessary equipment and materials essential to first class enlargement production. Mr. Foldes is at his best, in this reviewer's opinion, in [illegible] ment. Dodging and burning-in, flashing, vignetting, combination printing, border printing, photograms, using *New Coccine*, print intensification and reduction, and print finishing [illegible].

The book was no doubt written for the amateur photographer, but there are few professionals who would not learn much from the techniques presented by Mr. Foldes. This book is highly recommended.

COLOR — HOW TO SEE AND USE IT, *Fred Bond, Camera Craft Publishing Co., 95 Minna St., San Francisco 5, Calif., 167 pages (1954), illustrated, 10¾ in. x 8 in., heavy paper, spiral bound, $8.75.*

Here is a book that most color photographers have long waited for. It is a book on the subject of color itself, and not on color photography. The attributes of color, based mostly on the *Munsell System*, are well described and illustrated in color. Mr. Bond takes the position that it is not enough to think that the good or bad use of color is simply a matter of [illegible]. It seems to us that surrendering to such a viewpoint is admitting to chaos. Since there is order in the world of color there must be certain rules that produce such order. From this premise he sets out to describe how colors, in all of their attributes, are interrelated, and how an organized system or understanding of color can be put to practical use in art and photography. There are certain points of fact and certain opinions expressed which one might criticize; but all in all, the book is extremely well done. The publishers are to be complimented on such a fine book production at [illegible].

RECOLLECTIONS OF A LIFE PHOTOGRAPHER, *Wallace Kirkland, Houghton-Mifflin Co., 2 Park St., Boston, Mass., 272 pages (1954), 5½ in. x 8¼ in., cloth bound, $3.50.*

The author has been a *Life* photographer since the magazine's beginning. This book consists of the story behind Kirkland's photographic assignments. As he stresses in the preface, it is not a technical photographic book. He has tried to take readers behind the scenes to tell them something of the things [illegible] range of assignments which *Life* editors put [illegible].

Covering a period of some 15 years, the book is an exciting story of an extremely interesting period. But it also points out that the work of a *Life* photographer is often [illegible]. [illegible] a most fortunate asset on many of my *Life* assignments through the years. They have been more important at times than any other part of me, including brains." Although admitting this, the author claims that keeping busy as a photographer has made him very happy. If you read the book, which you should do, you will understand why Kirkland would not trade his job for any other, in spite of the many trials and tribulations of a roving [illegible].

THE ROLLEI HANDBOOK, *Alex Pearlman, The Fountain Press, Hayelle Publications, 5700 Oxford St., Philadelphia 31, Pa., 169 pages, 1½ in. x 6 in. (1954), illustrated, heavy paper bound, $2.95.*

Mr. Pearlman is a well-known user of *Rollei* [illegible]. His previous book, *The Rolleiflex Manual*, proved so popular that it is now out of print. This new "Handbook" supplements the author's previous manual and gives complete working data on the *Rolleiflex*, *Rolleicord*, and *Sports Rolleiflex* cameras. The text is written very much to the point, with a minimum of filler. It is accompanied by numerous, excellent illustrations, both of line drawing and pictorial types.

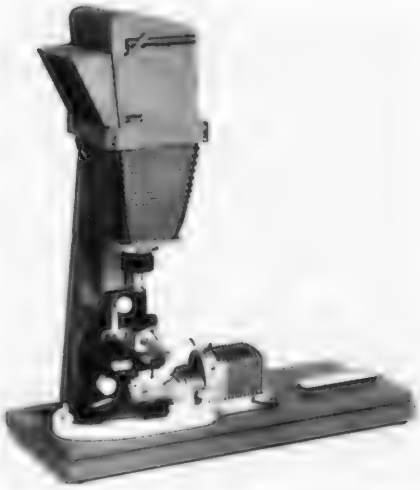
PICTURE MAKING WITH THE ARGUS, *Jacob Deschin, Camera Craft Publishing Co., 95 Minna St., San Francisco 5, Calif., 128 pages 1954), illustrated, 6 in. x 9 in., heavy paper bound, $3.00.*

Jacob Deschin is famed for his breezy, instructive style of writing. He not only does a considerable amount of popular writing in photography, but he also does an equal amount of picture taking. There is perhaps no one better equipped to put a camera through a series of rigid tests and then advise other people what is required to get the most from [illegible]. Mr. Deschin has set out to prove this ability in his present book. It contains 15 chapters, the first 8 covering more or less the [illegible] of the Argus camera, followed by chapters on exposure, lenses for [illegible], close-up work, prints from Argus negatives, and finally a historical survey tracing the development [illegible].

The excellent reproductions of which [illegible] about 130 including 6 in full color; [illegible]; the varied uses of color — and the fine printing job on coated stock, all reflect the anxiety of the publisher to spare no effort, despite the moderate list price of the book, to maintain a very high standard. As a result, the book has dignity without dullness, and all the facts,

New Products

NEW MICROSCOPE ILLUMINATOR



BOOK ON NEW ENLARGER

NEW FOLDER DESCRIBES KODAK MICROPRINT READER

Eastman Kodak Company has just published a folder describing and illustrating the new Kodak Microprint Reader, a device designed to be used in offices and libraries where literature and reference books have been reduced to microprint cards. Printed matter can be reproduced photographically at a reduction of 20 times linear size on standard size microprint card, or letter size material can be reduced 40 times linear size on a 3 by 5 inch card. Microprint cards are being published in many fields by the Kodak Publication Agency, Dayton, Ohio. Copies of the folder, entitled "Kodak Microprint Reader," may be obtained on request to Industrial Sales Division, Eastman Kodak Company, Rochester 4, N. Y.

TWO NEW STROBOFLASH UNITS ADDED TO LINE

With the addition of Stroboflash II and Stroboflash III, the Graflex line now includes four models of electronic flash units. Stroboflash II is a 200 watt-second unit with a guide number 56 for color film. Color number for color film is 50 to 95. Price $99.95.

Stroboflash III is a 400 watt-second unit with a guide number 70 for color film. Color number for color film is 65 to 95. Price $129.95.

Stroboflash II and III are capable of 5,000 flashes with dry cell batteries. Both units have delayed action. Designed to replace every electronic model that has simple brush contacts to synchronize the flash. Color photography guide number 56 to 70. Stroboflash II uses the same flash tube as Stroboflash I and a unit 3 inch higher and weighs only 1½ lbs. more. Both units' accessories are interchangeable with Stroboflash II. Price $159.95.

NEW CAMERA SUPPORT

Mann Inventions Corporation, Denver, Colorado, have introduced a new camera support called the "Mann-Lock." Designed to replace the tripod, it consists of tubular aluminum. A curved aluminum piece shaped like a bent "U" fits over the camera as shown in illustration. The adjustable extension has a pistol grip fitting at the other end. Price

NEW RONDINAX TANK

NEW TRAVEGON TELEPHOTO LENS

ANSCO SUPER REGENT CAMERA FIRST MINIATURE TO HAVE NEW COMPUR LVS SHUTTER

KORONA FOTO ROLL 70

NEW EDITION OF ANSCO BOOKLET

DU PONT ANTI-STATIC SOLUTION

[illegible] filters for Varigam variable contrast [illegible] paper is available to supplement the small vial supplied with the inlet set. Only one drop of the solution, rubbed on each side, is needed to minimize static and dust-attracting [illegible] filter.

HICO-LITE, MODEL 109

[illegible] vantages of other types of electronic flash [illegible] or 'hot spot' in the center of the field. The [illegible] tained evenly over the entire field, permitting use of a guide number with Kodachrome of 40-50. The flash duration is approximately 1 [illegible]

NEW 500mm (20-INCH) TEWE TELEGON TELEPHOTO LENS FOR EXAKTA CAMERAS

[illegible]

TWO NEW KODAK HIGH-SPEED MOVIE FILMS

[illegible] and in which extremely rapid processing at high temperatures is desirable. While not as fast as the negative film, it has 50 per cent [illegible]

ANSCO INCREASES COLOR MOTION PICTURE PROCESSING FACILITIES

[illegible] film, both black and white. Less than one year after [illegible]

Your Association

A section of the Journal devoted to official announcements, chapter events, and other matters of historical significance to the Association.

MISCELLANEOUS NOTES

1954 Membership Directory of the Association of Medical Illustrators

Miss Muriel McLatchie Miller, Editor of the A.M.I. Directory has kindly sent us a copy with the advice that the Directory is available to all scientific and other personnel in allied fields at the price of $1.00. The Directory has a two-fold purpose: 1.) as a catalog of the A.M.I. members, 2.) as a helpful guide to the medical professio

We noted several B.P.A. members listed, but one listing has us stumped. Tom Jones is given as a "Consultant Member" of the Biological Photographic Association

Those interested in obtaining a copy of the Directory should write to the Editor, care of Medical Art Department, Massachusetts General Hospital, 30 Fruit St., Boston 14, Mass

Annual Report of the University of Durham.

One of our members in England, Mrs. C. J Duncan, has kindly sent us a copy of the most recent Annual Report of the Department of Photography of the Medical School, University of Durham, King's College. Mr. Duncan is Director of the photography department and the report shows that he and his staff of 13 people have been exceedingly busy. The department averages 138 jobs per month. The total number of items supplied was 19,220 The number of [illegible] produced was twice the number of standard slides. Also, the number of black-and-white slides was double the number of color slides. The number of prints produced was roughly three times that of the number of slides. Many other interesting details are given in graphs and tables in the report

Note from Ralph Creer.

Well-known B.P.A. member, Mr. Ralph P Creer, Secretary of the Committee on Medical Motion Pictures, American Medical Association, has called our attention to a paper entitled "Operation for Coronary Artery Disease" by Claude S. Beck, M.D. and David S. Leighninger, M.D., (Journal A.M.A., November 27, 1954) which contains 20 illustrations, 8 of which are in color. In Mr. Creer's opinion, this paper is one of the best that he has seen for some time from an illustration standpoint. Since most B.P.A. members have access to the J.A.M.A., it might pay to take a peek at this paper

New Position for Margaret L. Engel.

We have been advised that Miss Margaret L. Engel is now the Assistant to Mr. Allen F. Hancock, FBPA, at the Jefferson Medical College and Hospital in Philadelphia

Dr. Farris Given Special Award.

On January 7, 1955 Dr. "Ed" Farris, Past President of B.P.A., received a special citation from the University of Buffalo for "outstanding medical research"

Member Death.

We regret to record here the death of B.P.A member Lewis A. Waerner who passed away on December 23, 1954

Tragic Death of Leo Massopust's Eldest Son.

The home of well-loved B.P.A. member Leo Massopust was saddened by the accidental death of David Massopust, Leo's oldest boy. Daniel and a friend were fishing at Okauchee Lake. When the boat turned over, Daniel drowned. Knowledge of this most unfortunate accident reached Mr. Massopust upon his return to Milwaukee following the B.P.A. Annual Meeting in Atlantic City

In behalf of all of Leo's many friends in B.P.A. we extend our sympathy to him and his family

FACTS . . . YOU SHOULD KNOW ABOUT THE BPA GROUP INSURANCE PROGRAM

During a recent review of the Biological Photographic Association Group Insurance Program, Mr. Mervin LaRue, B.P.A. representative working with the Group Insurance Administration Office, reported that since its inception just six months ago, our program has performed an outstanding service in providing invaluable protection to the membership. Interest in the program is evidenced by the increasing number of members who are enrolling for coverage under the various plans available.

Through the B.P.A. Sponsored Group Program of Sickness and Accident Disability Insurance, members can protect their income if disabled, up to $400.00 per month. Because of the group purchasing power of the B.P.A. and the economies of group administration, the cost of this comprehensive coverage is substantially less than comparable protection purchased on an individual basis.

You personally gain these outstanding advantages through the B.P.A. Group Program:

1) Sickness benefits payable up to two years.
2) Accident benefits payable up to lifetime.
3) Benefits for accidental loss of use of hands.
4) Benefits for accidental loss of life.
5) Benefits for accidental loss of limbs.
6) Additional benefits while hospitalized.
7) $5,000.00 reimbursement for expenses incurred in the treatment of polio and seven other dread diseases, and you may include your dependents.
8) Special benefits for partial accident disability.
9) Special benefits for non-disabling injury bills.
10) House confinement is never required.
11) Premiums never increase nor do benefits decrease because of age.
12) Coverage individually non-cancellable to age 70.
13) Benefits payable for each period of disability.
14) Benefits payable regardless of other insurance you carry.
15) World-wide coverage, including commercial scheduled air travel.

The correspondence and enrollment in connection with this coverage and the billing and collection of all premiums are handled directly with the insured by the Group Insurance Administration Office, the Joseph K. Dennis Company of Chicago. All claims are handled by this company through its principal administration office, which assures us of prompt payment of all benefits due the insured.

For further information regarding the Program, please write the Group Insurance Administration Office at Suite 1027, 175 W. Jackson Blvd., Chicago 4, Illinois.

NEW B.P.A. MEMBERS

(October-December, 1954)

John D. Abbott, M.D., *Rochester, N.Y.*
Theodore Blank, *Dorchester, Mass.*
Samuel E. Cohen, M.D., *Binghamton, N.Y.*
Harold R. Dettelbach, *Skokie, Ill.*
Albert E. Dillard, *Los Angeles, Calif.*
Fred W. Faust, *Milwaukee, Wis.*
Franc Richard Francis, *Seneca Falls, N.Y.*
Dr. E. M. Gaynes, *Detroit, Mich.*
Cecil D. Gilham, *West Lynn, Mass.*
W. S. Goldwire, *Madison, Wis.*
Ray Miess, *Milwaukee, Wis.*
Byron A. Myhre, *Wichita Falls, Tex.*
Kathleen A. Riley, M.D., *Charleston, S.C.*
George R. Ringer, *Bloomington, Ind.*
Harvey Steinberg, *Chicago, Ill.*
Walter W. Taylor, *Oklahoma City, Okla.*
Charles L. Willmarth, M.D., *Geneva, N.Y.*

CHAPTER NEWS

L. B. Brown, Chairman, Chapters Committee

Boston: A most enjoyable meeting was held at the Museum of Fine Arts in December. Mr. Young, head of the Museum Research Laboratory spoke on "The Detection of Forg[illegible] of Art". He demonstrated the varied and extensive use of photographic and roentgenographic procedures in this work. An excellent dinner was enjoyed by all in the museum Cafeteria.

In January we met at the Harvard School of Dental Medicine to have a panel discussion entitled "The Low-Down On Photographic Equipment". Dave Feigenbaum gave us the retail sales angle; Dick St. Clair the technical photographer's point of view; and Cleon Ball [illegible] the care and repair slant. Questions were [illegible] and [illegible] were all printed by the [illegible] Office and those [illegible] appeared rapidly.

Southern California. [illegible] meeting was held at the Los Angeles County Museum. Two movies: "Photoengraving", and "Quality in Photographic [illegible]" by Eastman Kodak were shown. Lloyd Matlosky was challenged to make "Simple Sensitometry" simple and Phil Bleitcher spoke on "Phase Microscopy Applied to Photomicrography."

The December meeting was devoted to touring the "Times Mirror" which must have been interesting and informative.

In January Mr. Rudolph Sabbot of the Moody Institute showed a film on "Insects Come to Life". Mr. Leland Brown of the Department of Entomology, U.C.L.A., gave a short discussion of the Ektolith process. Mr. William Sokol of Erb and Gray discussed "The [illegible] Power of Objectives with Diatoms".

Highlight of the February meeting was a discussion of "General Principles Involved in the Preparation and Use of Slides and Graphs". A series of slides, prepared by the Armed Forces Institute of Pathology, on the [illegible]

Personal News Items: George [illegible] former President and present member of the Board of Directors, was given the A.P.S.A. Award. We all join So. Cal. in saying "Congratulations, George."

[illegible] a new course in [illegible] U.C.L.A.

Dan Green of [illegible] a panel relative to medical photography before the American Academy of Dermatology and Syphilogy in Chicago. They had an opportunity to get in a few good words about the B.P.A.

Avis Gregersen did the photomicrographs for a Navy Exhibit on "Systematized Histopathology". Said exhibit won first prize for [illegible]

Chicago: The January meeting was held at the University of Illinois College of Medicine. Mervin LaRue presided [illegible] and Different Ways to Make Them". Following this, Paul Jorgensen was moderator for a "Problem Symposium."

In February the Annual Business Meeting [illegible] Encyclopedia Britannica Films and "Motion Picture Production in the Biological Sciences."

Central Indiana: A meeting was held in September at which time the President, Mr. Albright, spoke about the B.P.A. and what it stands for. Plans were made for meetings for the ensuing year. As the second part of the program an Exa electronic-controlled flash camera was demonstrated as a useful and easy method for the doctor to take his own office pictures.

In October there was a demonstration of a dry process for making lantern slides that Mr. Albright and Mr. Cave have perfected.

In November several interesting motion pictures lent by Lieber Bros. were shown. One was an illustration of what a 16mm Fastex Camera can do. A Verifax Print Machine was also demonstrated which copies [illegible]

The first part of the December meeting was held at the I.U. Medical Center. Mr. Johnson presented a paper "Suggestions on the Part of the Photographer". The meeting was then adjourned to the V.A. Hospital where Mr. Davis demonstrated the color trans[illegible] Mr. Cave, Chief of the Illustration Lab, [illegible]

At the January meeting there was a round table discussion on lantern slides with a fruitful exchange of ideas.

Upper Midwest: The winter meeting of this chapter was held February 12 and 13 at the [illegible] Program was as follows:

The Mechanics of Ultraviolet Light in Photographing Biological Fluorescence" by LeRoy Christensen, University of Minnesota.

[illegible] for Teaching Dentistry" by James Rotherberger, University of Minnesota.

"Broader Horizons for Color Photograph[illegible]

"Electron Microscope and Its Relation to Photography" by Dr. J. Francis Hartman, Associate Professor of Anatomy, University of Minnesota.

Following the Scientific Session members and visitors were guests of Century Radio and Camera Stores, Inc., at a cocktail party.

Sunday morning there was a guided tour of the new Mayo Memorial Hospital.

Personal News Items: Wendell Holmquist has designed and is distributing "Match Me"

photographic lamp shades. Those who have made them up from the kit have been most enthusiastic.

E. Lynn Baldwin is proud of his new space, including studio and darkroom at Still College. (How did he ever manage it — wish we could.)

Philadelphia: In October, Samuel J. Mink of Saunders Publishing Co., an experienced commercial photographer as well as publisher, spoke on "Some Highlights of Medical Illustration and Publishing Aspects".

November 18th was "Trade Night" presented by Du Pont, Eastman Kodak, Photomart, and Webb and Co. The latest information on new equipment, supplies, trends and methods were discussed.

In February there was an election of officers (sorry we have not been notified of the results yet), and one of Hollywood's leading technical experts in the motion picture field, Mr. Richard Newmayer, presented "The Technical End of Motion Pictures", illustrated with sound film and slides.

Texas: In December the Texas Chapter with Mrs. Breckenridge as program chairman held a two day workshop on photomicrography at the V.A. Hospital in Houston. Mr. Paul Flory helped organize and participated in the program which was attended by 37 V.A. Medical Photographers in addition to the Texas Chapter. They covered the field from the anatomy of the microscope to phase contrast cinephotomicrography.

Wisconsin: A meeting was held at Strobe Research where a demonstration was given on electronic flash equipment. Members were also provided with free lunch and movies.

Leo Massopust reported on plans for the '55 Annual Meeting. They hope to make this the biggest and best ever. Sounds good — let's make *our* plans now to go.

W. J. Young demonstrating a process for detecting forgeries in works of art at Museum of Fine Arts. Members of Boston Chapter are left to right: George Buchanan; Don Withee; Cleon Babcock; Dave Feigenbaum; George Wiggin.

P. C. Johnson, staff photographer at Indiana University School of Medicine, delivering his paper "Suggestions for the Photographer" before Central Indiana Chapter. Seated clockwise around the table: McKinley Leapley; Frank Davis; Richard Scott; Mr. Johnson (standing); Robert F. Albright; George Cave; Meade Willis; E. K. Sims; Morris J. Pickett.

25th
ANNIVERSARY
Annual Meeting
of the
Biological Photographic Association
MILWAUKEE, WISCONSIN
August 30-31 • September 1-2
Headquarters: WISCONSIN HOTEL
General Chairman
LEO C. MASSOPUST
MARQUETTE UNIVERSITY
SCHOOL OF MEDICINE
Milwaukee 3, Wisconsin

CONTRIBUTING MEMBERS

Allan J. Allston
Dean C. Altman
A. Andreeko
Anonymous
Harold C. Baitz
Dr. Edgar C. Baker
A. V. Banones
Edna Campbell Barker
Earl C. Bartlett
John J. Beiter
Tibor Benedek, M.D.
Robert E. Bevis
Keturah Blakely
Rush Maxwell Blodget, Jr., M.D.
Percy W. Brooks
Laurence B. Brown
Robert A. Brown
C. G. Brownell
James E. Brubaker
Joseph D. Brubaker
Cora T. Burgess
Jasper D. Bush, Jr., M.D.
Maurice O. Button
William J. Cameron
William H. Campbell
Julian Carlile
Herman R. Chandler
Allen S. Clarke
Philip A. Conrath
Marian K. Dawes
C. G. de Gutierrez-Mahoney, M.D.
Edward Drewello
P. K. Duraiswami, M.D.
Wayne Eastman
C. Graham Eddy
Dr. Edmond J. Farris
Jack Fason
Louis Paul Flory
A. Wilson Footer, M.D.
Jay T. Fox
Jerome A. Gans
Larry Gaskins
Eugene J. Gatze
John A. Gaughan
Boas E. Gibson
H. Lou Gibson
Luther R. Gilliam
Jane K. Glaser
D. M. Glover, M.D.
Gerald A. Gombert
Fritz W. Goro
Rev. A. J. Grant
Alex A. Gravesen
Bruce Gray
Avis Gregersen
Richard D. Grill
Ferdinand R. Harding
Hal B. Hayes
Rudolph J. Henning
Leslie E. Hier, Jr.
David Hilbrand
Constance Holland
Charlotte S. Holt
Nathan S. Horton
Wayne M. Hull, M.D.
John L. Isbister, M.D.
Joseph T. Jackson
Florence S. Jenney
Myrtle E. Johnson
M. George Jorgenson
Leonard A. Julin
Nathan C. Kantor
Anthony M. Kuzma
J. F. Kuzma, M.D.
Victor R. Landi
John M. Langton, M.D.
Thomas J. Lannon
Mervin W. LaRue, Sr.
Pierre J. LeDoux
Henry M. Lester
Albert Levin
K. Cramer Lewis
Gerald M. Lindley
R. P. Loveland
Don Loving
T. V. Maciejewski
Richard Malcomson
Robert Mallory III, M.D.
William L. M. Martinsen
Dr. George Matula
Ervin W. Miller
Joseph Edward Mineo
Clark Moore, Jr.
James A. Moore
Robert M. Moore, Jr.
Henry W. Morris
Robert T. Morrison
Charles Munson
Howard E. Murphy
Howard E. Murphy
Merwyn C. Orser
Edgar J. Pagé
William E. Perry
Leonard Perskie
Henry F. Pickett
Dorothy M. Pinkham
Robert G. Polk
Dr. Arthur W. Proetz
Dr. William Quijano
S. M. Rabson, M.D.
Harry Randall
Richard H. Ray
Chester F. Reather
Charles G. Reiner
George W. Reis
Rose M. Reynolds
Dr. Oscar W. Richards
Charles F. Rick, Jr.
Dr. Edward W. Robbins
Dr. George L. Royer
Frank Ruslander
Robert A. Sage
Lucien R. St. Laurent
Bernard Salb
Stirling C. Schmoyer
Dr. Richard C. Schiller
Sidney Shapiro
Anne Shiras
Paul J. Showstark
George B. Sickel
Dr. Fred Sielaff
Stanley D. Simmons
Norman N. Smith, M.D.
David M. Snaddon
George W. Spuda
William Stevenson
M. Victor Stokes, II
Warren Sturgis
Francis J. Sullo
Lewis J. Sunny
Joseph W. Tandatnick, M.D.
William J. Taylor
Dr. Harvey E. Thorpe
Howard T. Toenniges
Atlee S. Tracy
Harris B. Tuttle
Masaru Uehara
Lloyd E. Varden
Charles Walcott
Julius Weber
Samuel Weiss, M.D.
Laurence R. Whitman
Frank S. Wilbar
Leonard Winograd
Lloyd A. Wolf
Robert D. Wolf
Thomas L. Wood
Verlin Y. Yamamoto
Theodore Zbinden
Stella Zimmer

SUSTAINING MEMBERS

AMERICAN SPEEDLIGHT CORPORATION
ANSCO
BURLEIGH BROOKS COMPANY
ELGEET OPTICAL COMPANY
EXAKTA CAMERA COMPANY
GAMMA INSTRUMENT COMPANY
GRAFLEX, INC.
HARRISON & HARRISON
MEDICAL PRESS, INC.
PAILLARD PRODUCTS, INC.
POLAROID CORPORATION
SILGE & KUHNE
SIMMON BROS., INC.
W. M. WELCH MFG. CO.

FELLOWS of the ASSOCIATION

HAROLD C. BAITZ
JOHN J. BEITER
PERCY W. BROOKS
LAURENCE B. BROWN
JOSEPH D. BRUBAKER
JOHN V. BUTTERFIELD
JULIAN CARLILE
LARDNER A. COFFEY
RALPH P. CREER
J. W. GRUNELLE
C. GRAHAM EDDY
DR. EDMOND J. FARRIS
LOUIS PAUL FLORY
JAY T. FOX
ARTHUR W. FUCHS
H. LOU GIBSON
AVIS GREGERSEN
ALLEN HANCOCK
DR. PETER HANSELL
FERDINAND R. HARDING
JOSEPH B. HAULENBEEK
NATHAN S. HORTON
MARIA IKENBERG
LEONARD A. JULIN
MERVIN W. LaRUE
PIERRE J. LE DOUX
HENRY M. LESTER
ALBERT LEVIN
ROGER P. LOVELAND
DAVID LUBIN
ADOLPH MARFAING
WILLIAM L. M. MARTINSEN
LEO C. MASSOPUST
JOHN A. MAURER
STANLEY J. McCOMB
HENRY M. MORRIS
WILLIAM F. PAYNE
LEONARD L. PERSKIE
DR. ADRIANUS PIJPER
DR. ARTHUR W. PROETZ
CHESTER F. REATHER
DR. OSCAR W. RICHARDS
MAURICE N. RICHTER, M.D.
HENRY ROGER
DR. GEORGE L. ROYER
FRANK N. RUSLANDER
ALBERT SADLER
ROBERT A. SAGE
SIDNEY SHAPIRO
ANNE SHIRAS
WILLIAM STEVENSON
WARREN STURGIS
WILLIAM J. TAYLOR
HARRIS B. TUTTLE
LLOYD E. VARDEN
JULIUS WEBER
VERLIN Y. YAMAMOTO
H. WOLFGANG ZIELER
STELLA ZIMMER

FELLOWSHIP PROCEDURE

Members may propose for Fellowship in the BPA other members whom they consider worthy of recognition. To be eligible for Fellowship a candidate must have been a member of the Association for five consecutive years and must possess one or more of the following qualifications:

Superior craftsmanship in still or motion picture photography of biological subjects.

Ability in photographic research in new methods or materials.

(These require submission of evidence.)

Meritorious contributions to biological photography overall through sustained organizational work.

Two sponsors are required. The sponsors should be well acquainted with the candidate's work and should be ready to furnish the Board with details of his experience and achievements. Those who wish to sponsor a member whom they believe to be eligible should request a Fellowship Application form from the Secretary of the Fellowship Committee: Mrs. Maria Ikenberg, University of Illinois, 904 W. Adams Street, Chicago 7, Illinois.

CONTENTS

JOURNAL OF THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION

Volume 23, No. 1 — February, 1955

PHOTOGRAPHY OF SURGICAL AND RESEARCH APPARATUS . . . . Lardner A. Coffey 1

A NEW 35MM TECHNICAL CAMERA . . . . . Peter Hansell 12

STEREOSCOPIC PHOTOMICROGRAPHY WITH CAMERAS OF FIXED INTEROCULAR DISTANCE . . . . . Henry M. Lester and Oscar W. Richards 16

A SIMPLE, INEXPENSIVE SURGICAL CAMERA . . . . . Leslie E. Hier and James A. Dimond 29

A USEFUL, LOW COST DENSITOMETER . . . . Arthur W. Proetz 33

SOME NOTES ON UNDERWATER COLOR PHOTOGRAPHY . . . . Wilson A. Swanker 35

A SIMPLE METHOD OF CALCULATING EXPOSURE FOR CLOSEUP PHOTOGRAPHY . . . . . Margery P. Mann 36

CONTENTS MEDICAL AND BIOLOGICAL ILLUSTRATION 37

BOOK REVIEWS . . . . . Reviews by Editor except that noted by Oscar W. Richards 38

NEW PRODUCTS 41

YOUR ASSOCIATION 45

NEW B.P.A. MEMBERS 47

25TH ANNIVERSARY ANNUAL MEETING 47

CONTRIBUTING MEMBERS 48

SUSTAINING MEMBERS, FELLOWS OF THE ASSOCIATION, FELLOWSHIP PROCEDURE . . . . . Inside Back Cover

PRINTING BY HAMMERSMITH-KORTMEYER COMPANY, MILWAUKEE, WISCONSIN